

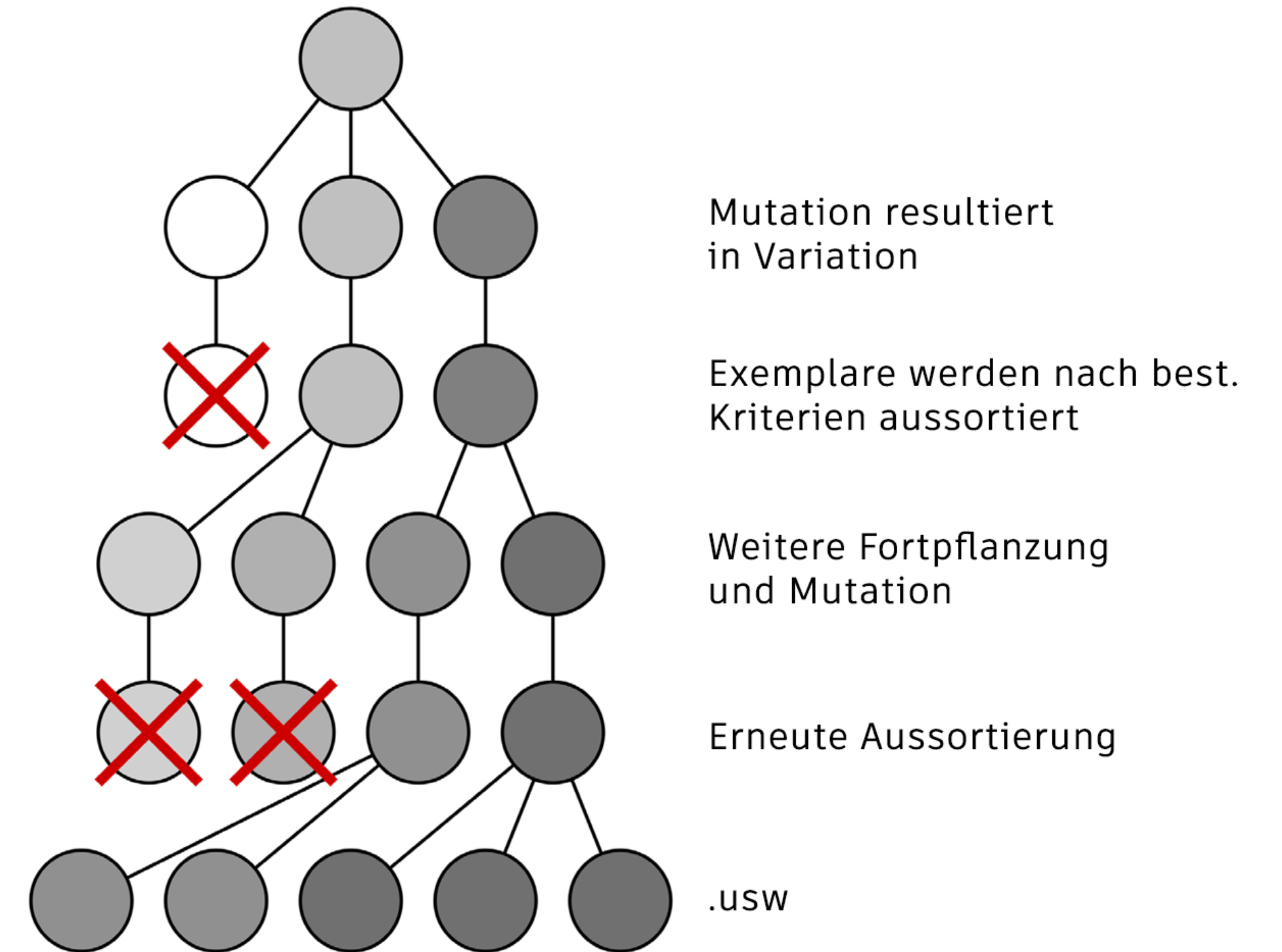
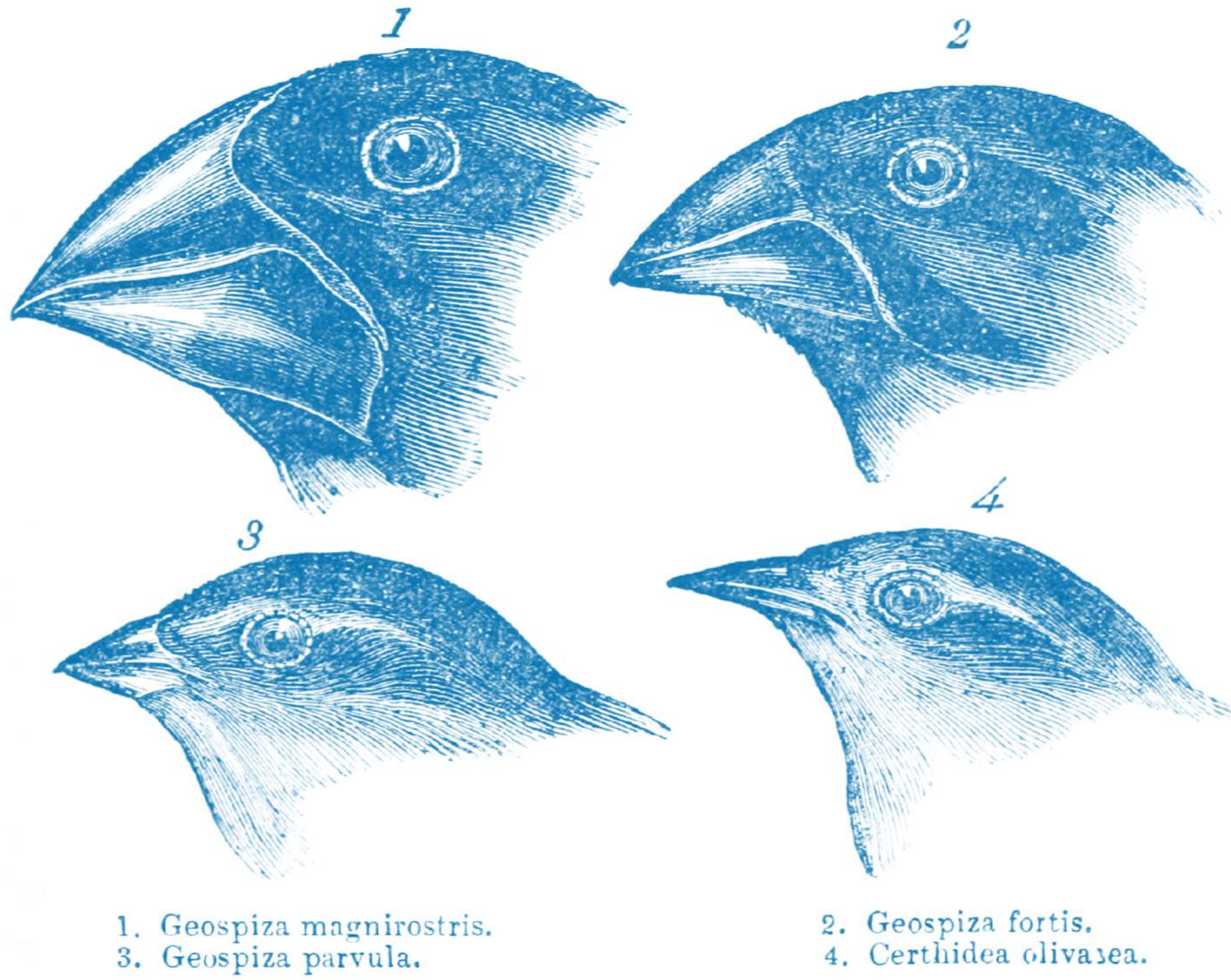
Generative Design für AEC

Lejla Secerbegovic

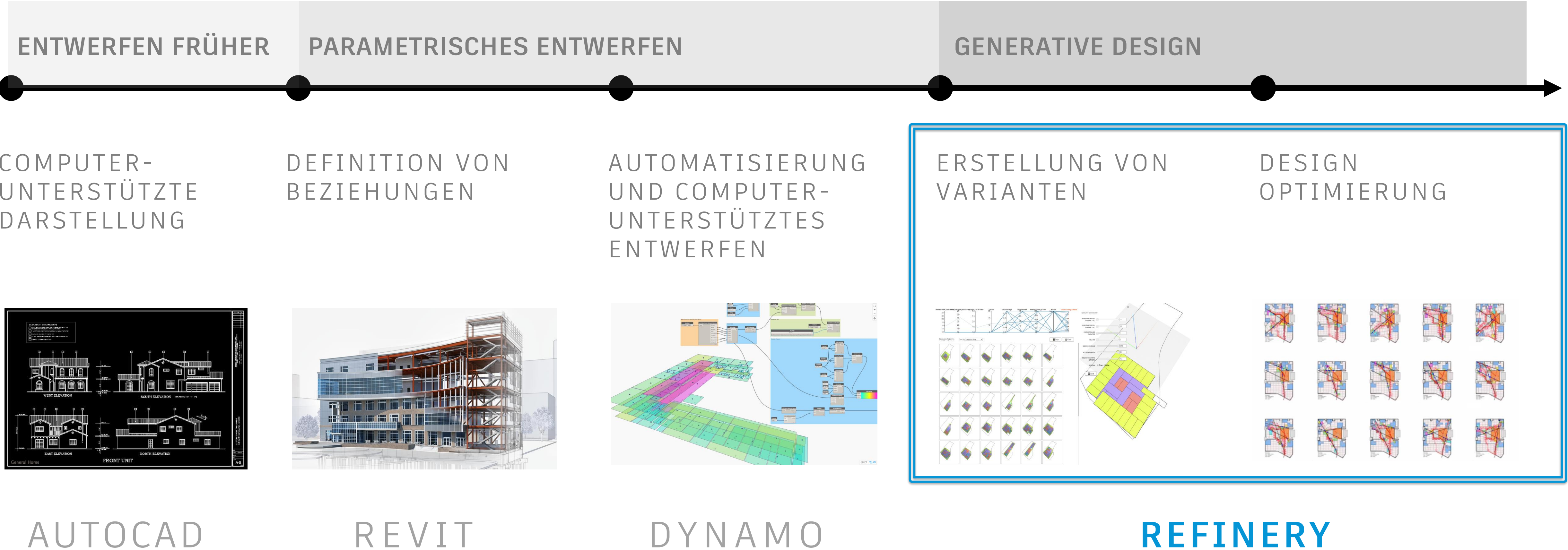
Arch. Dipl.-Ing. | Technical Specialist BIM

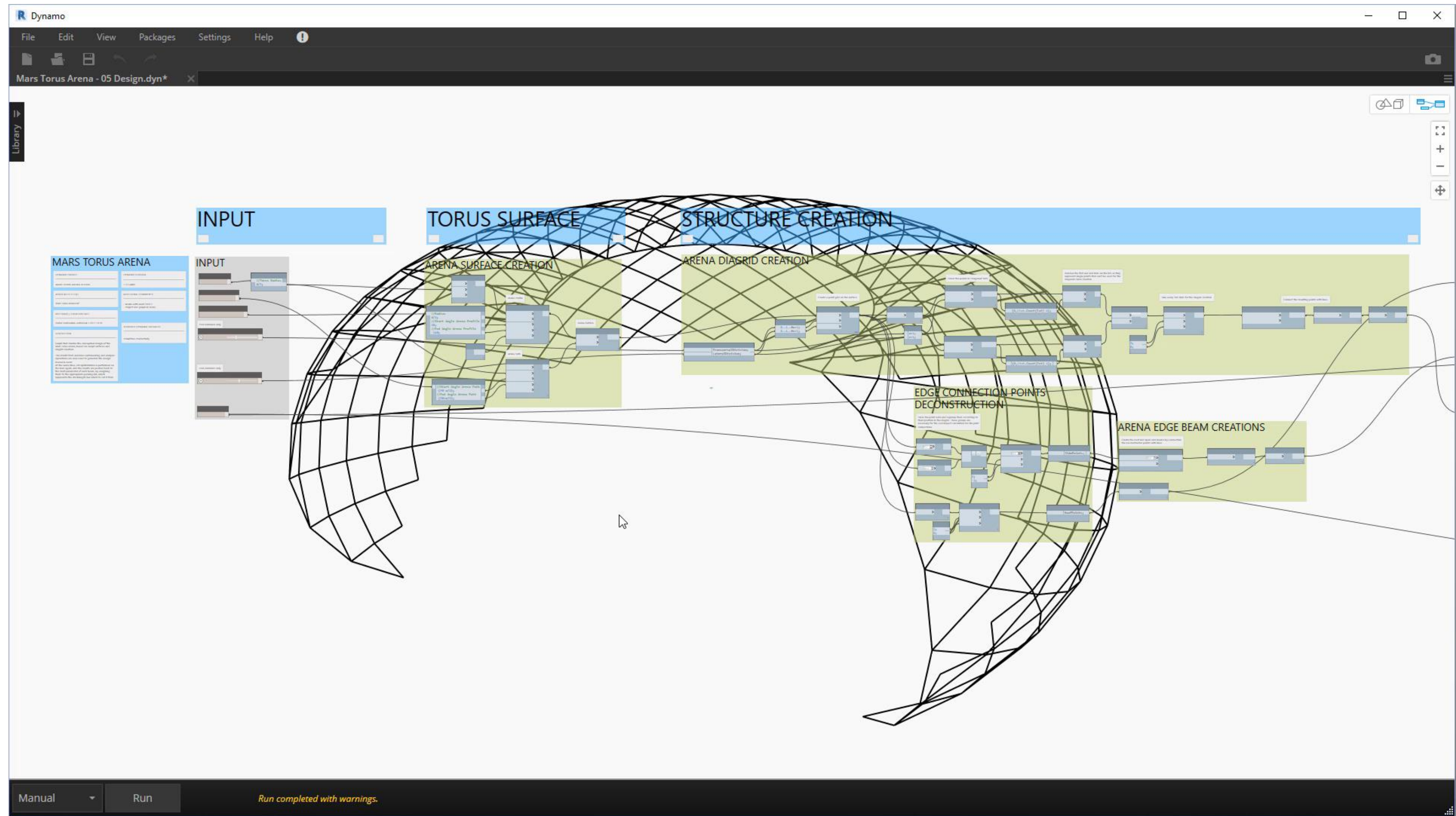


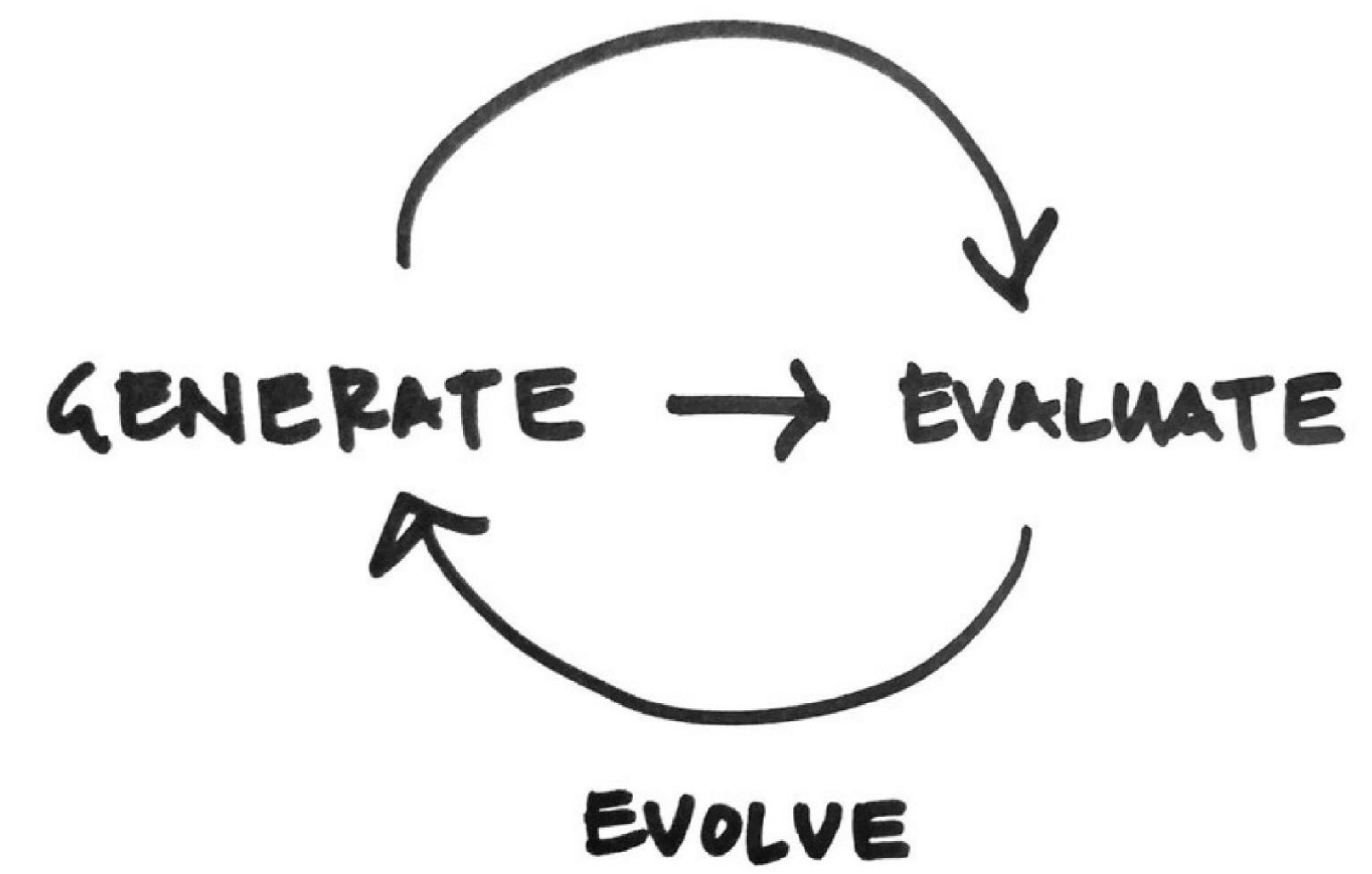
Definition Generative Design



Entwicklung der Entwurfsmethoden







An aerial photograph of a city skyline featuring a prominent modern glass skyscraper with a complex, multi-tiered design. The building's glass facade reflects the surrounding urban environment. In the foreground, there are older brick buildings and a street with some greenery. A semi-transparent blue banner is overlaid across the middle of the image, containing white text.

Generative Architectural Layout Autodesk Toronto @MaRS

+ Productivity

+ Collaboration

+ Buzz

Adjacency

Work-Style

Low Distraction

Daylighting

Views to Outside

Interconnectivity

Jewel Box

Vertical Connection Stair

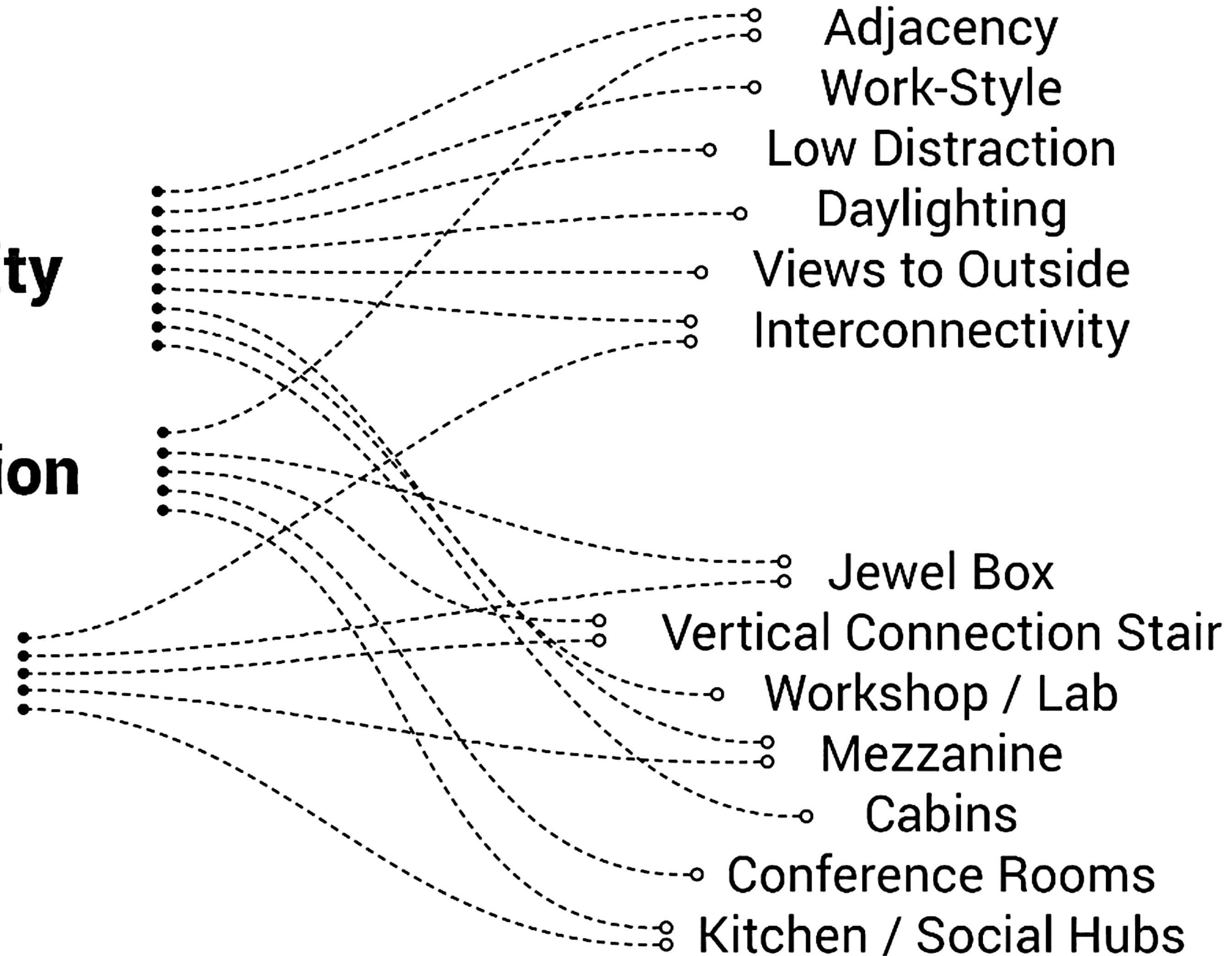
Workshop / Lab

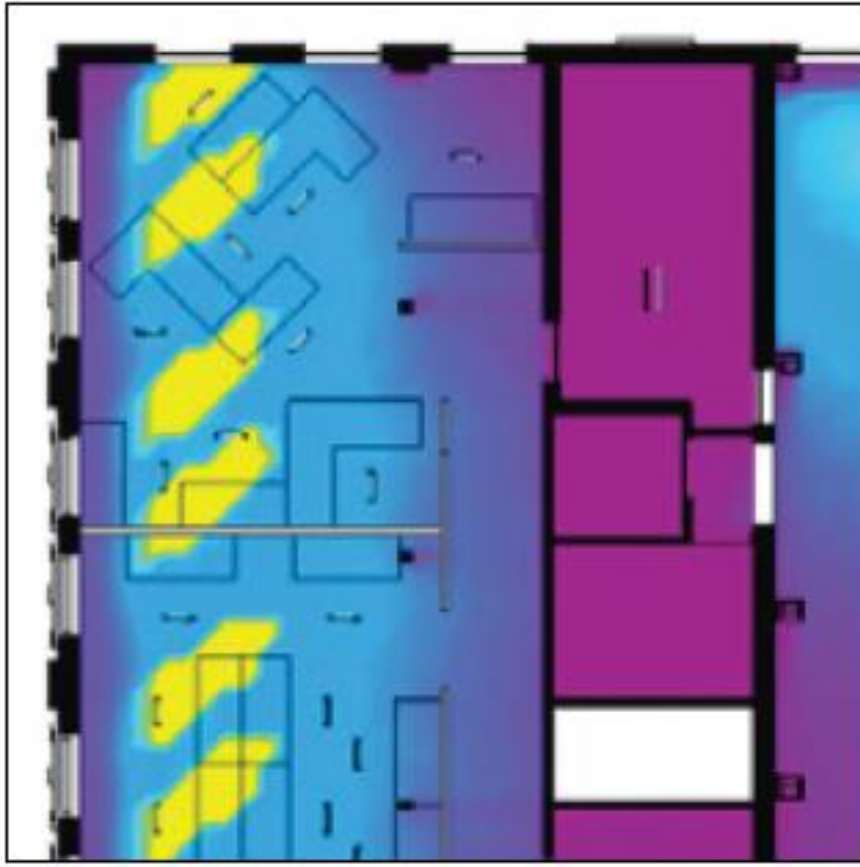
Mezzanine

Cabins

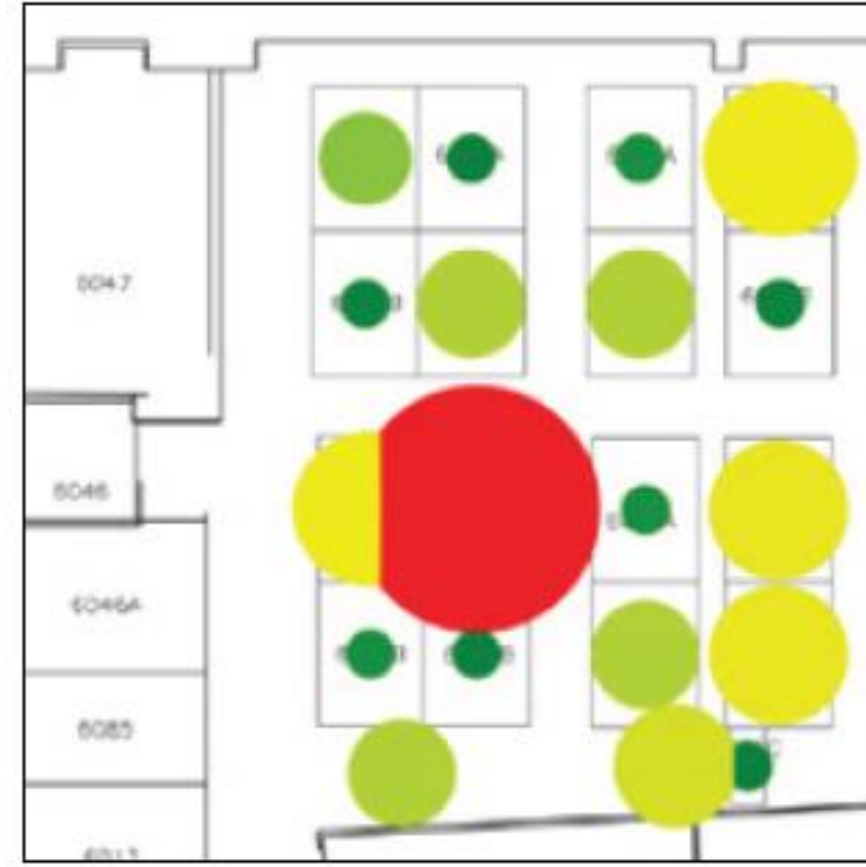
Conference Rooms

Kitchen / Social Hubs





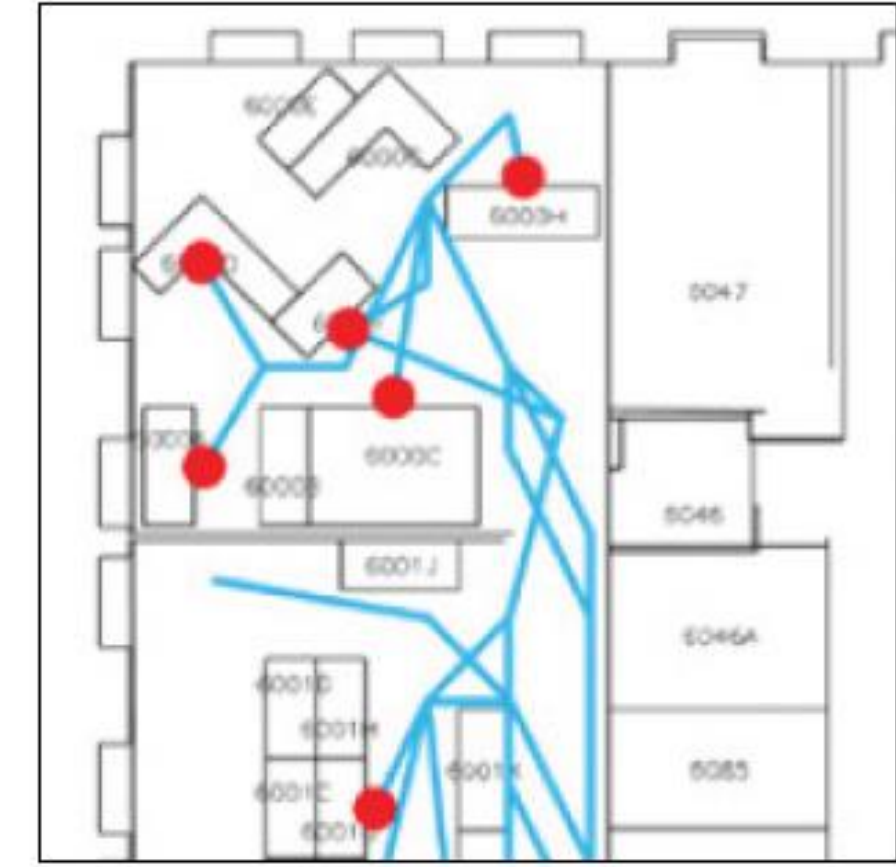
1. Daylight



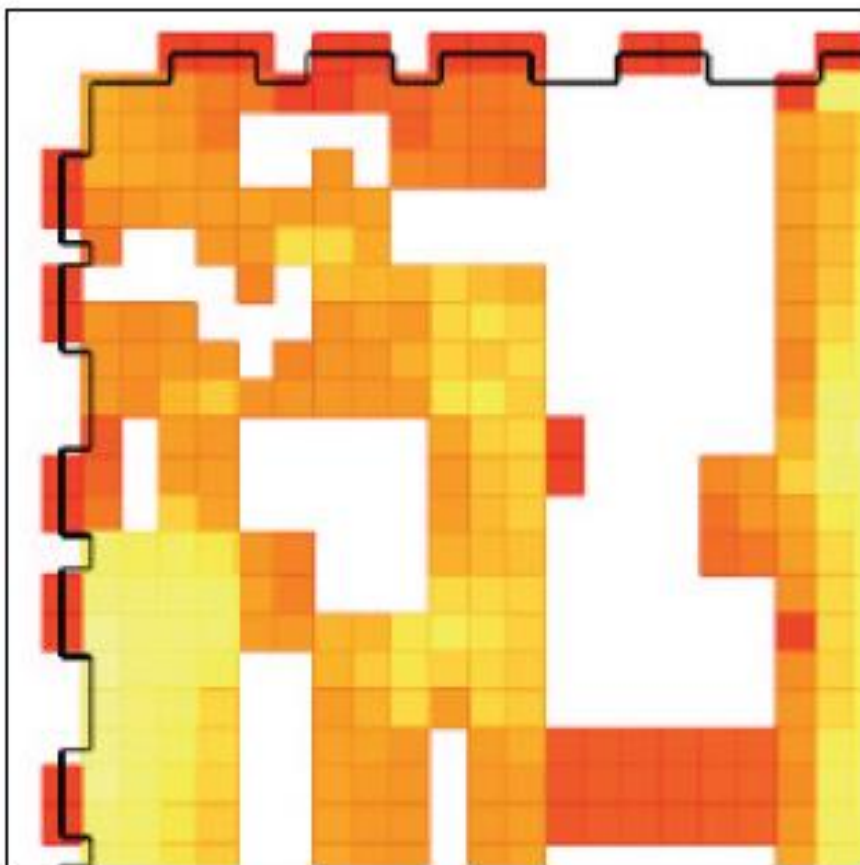
2. Low Visual Distraction



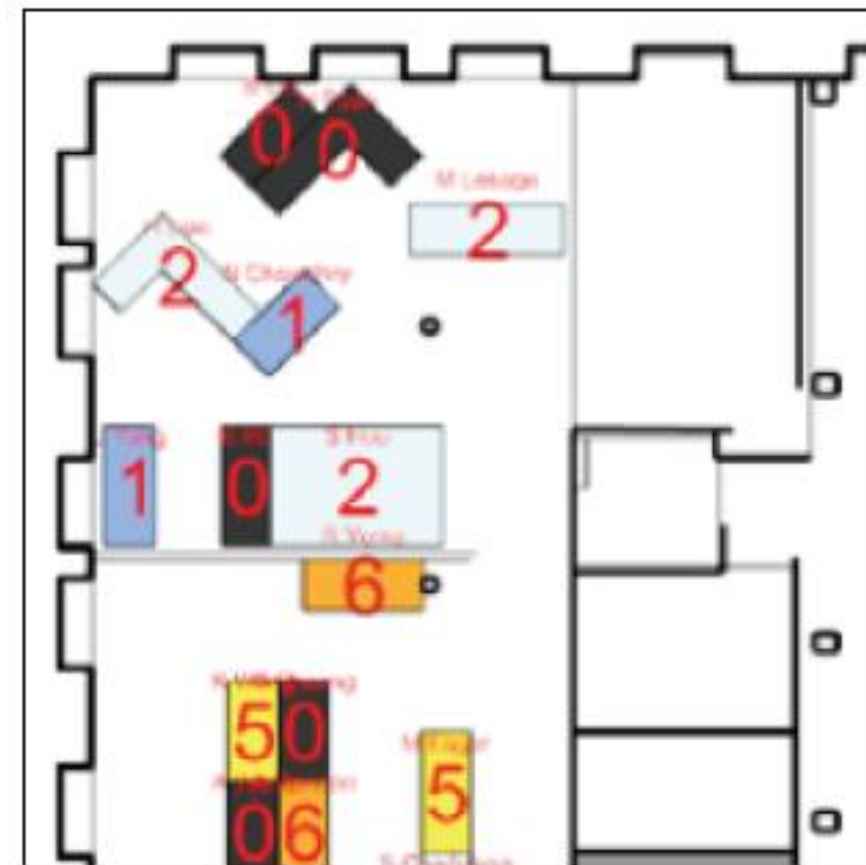
3. Views to Outside



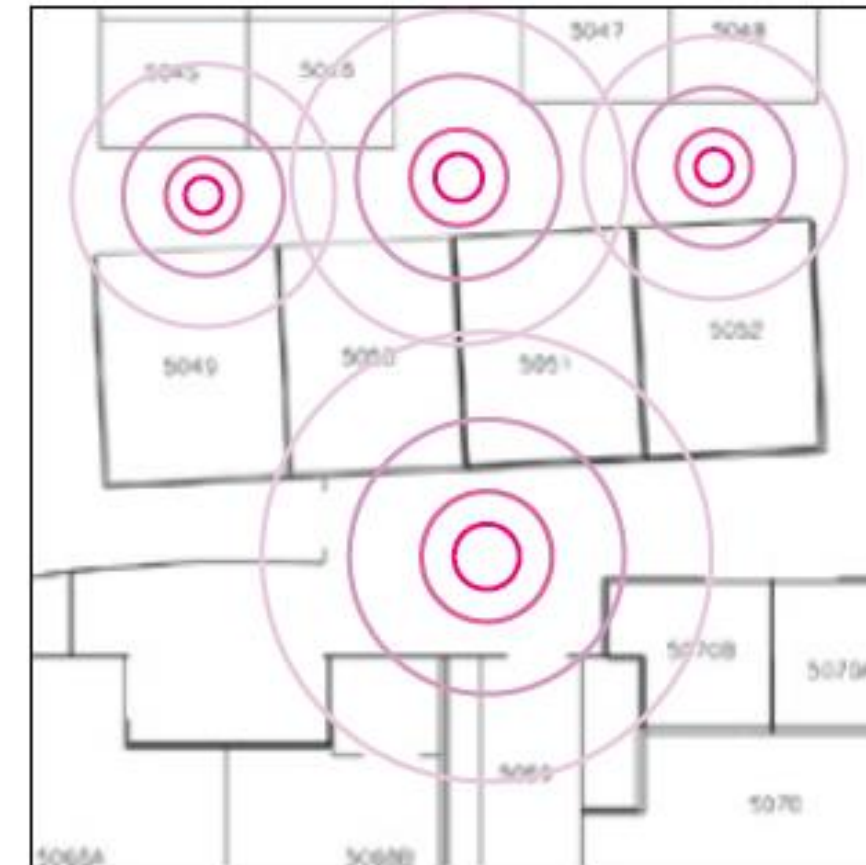
4. Adjacency Preference



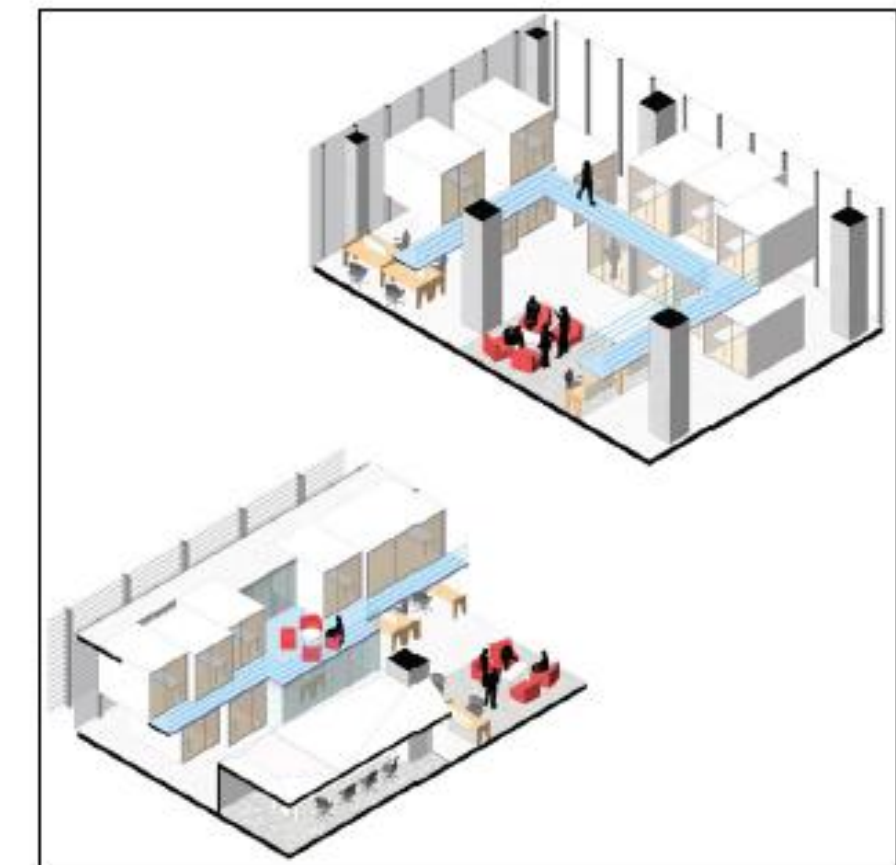
5. Circulation



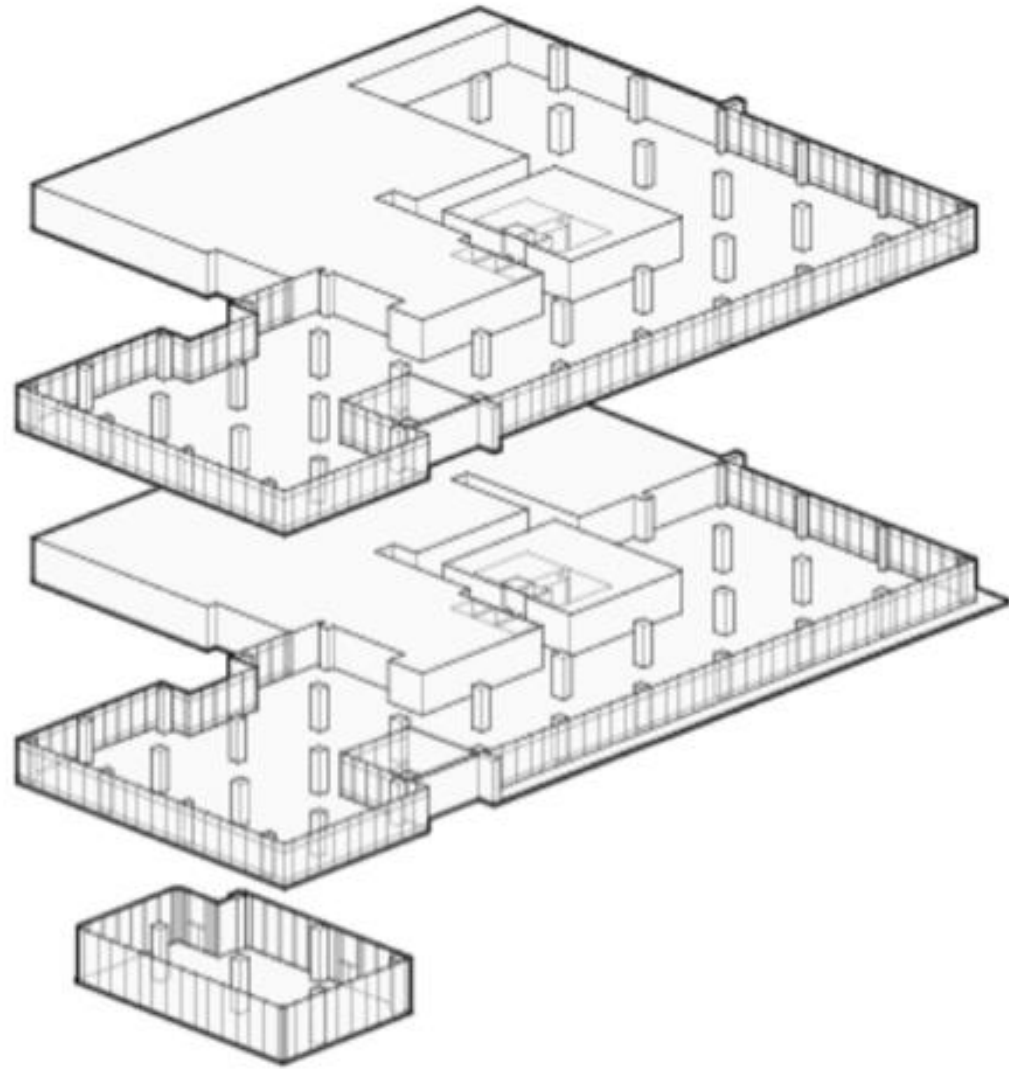
6. Work Styles



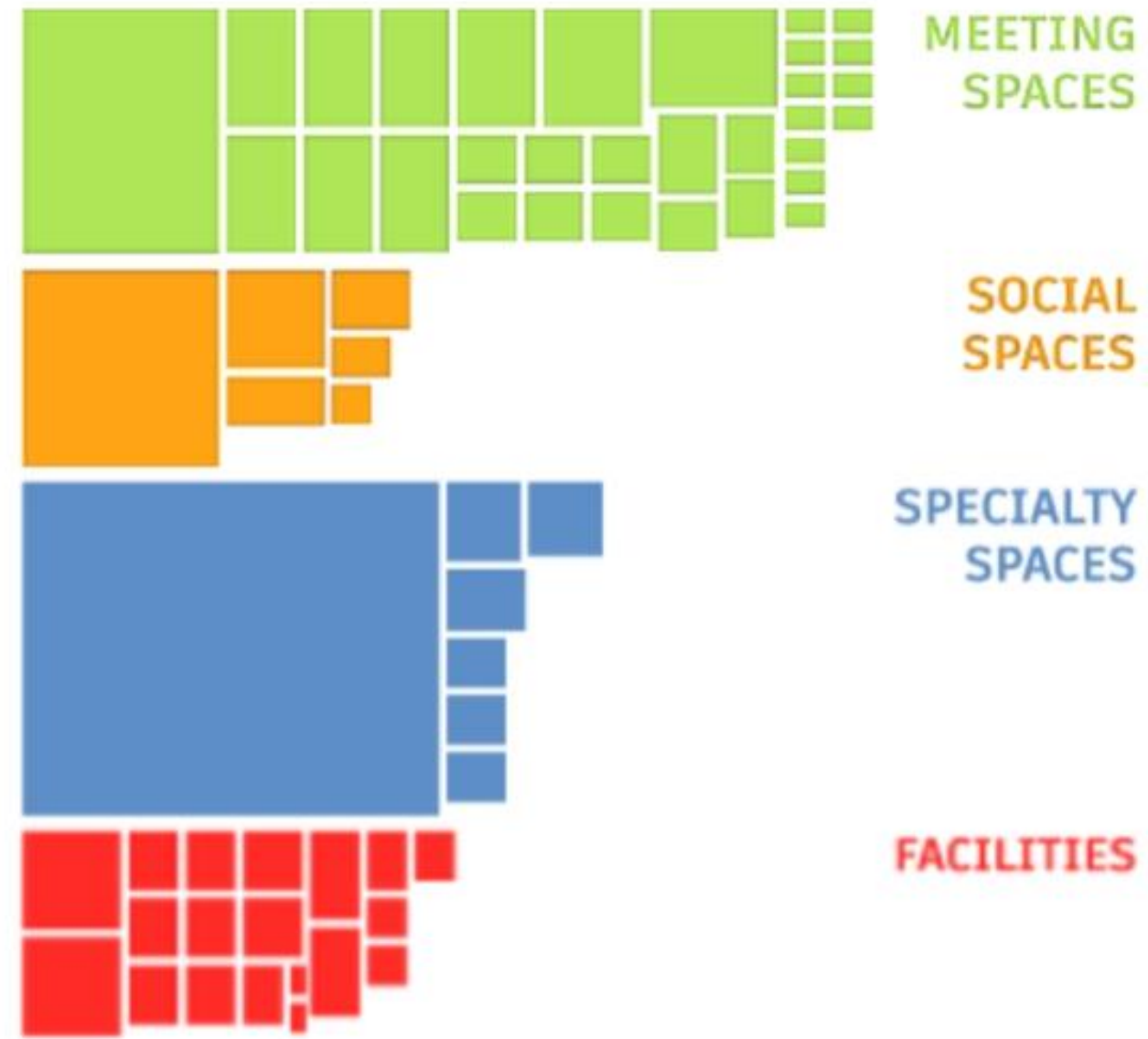
7. Low Acoustic Distraction



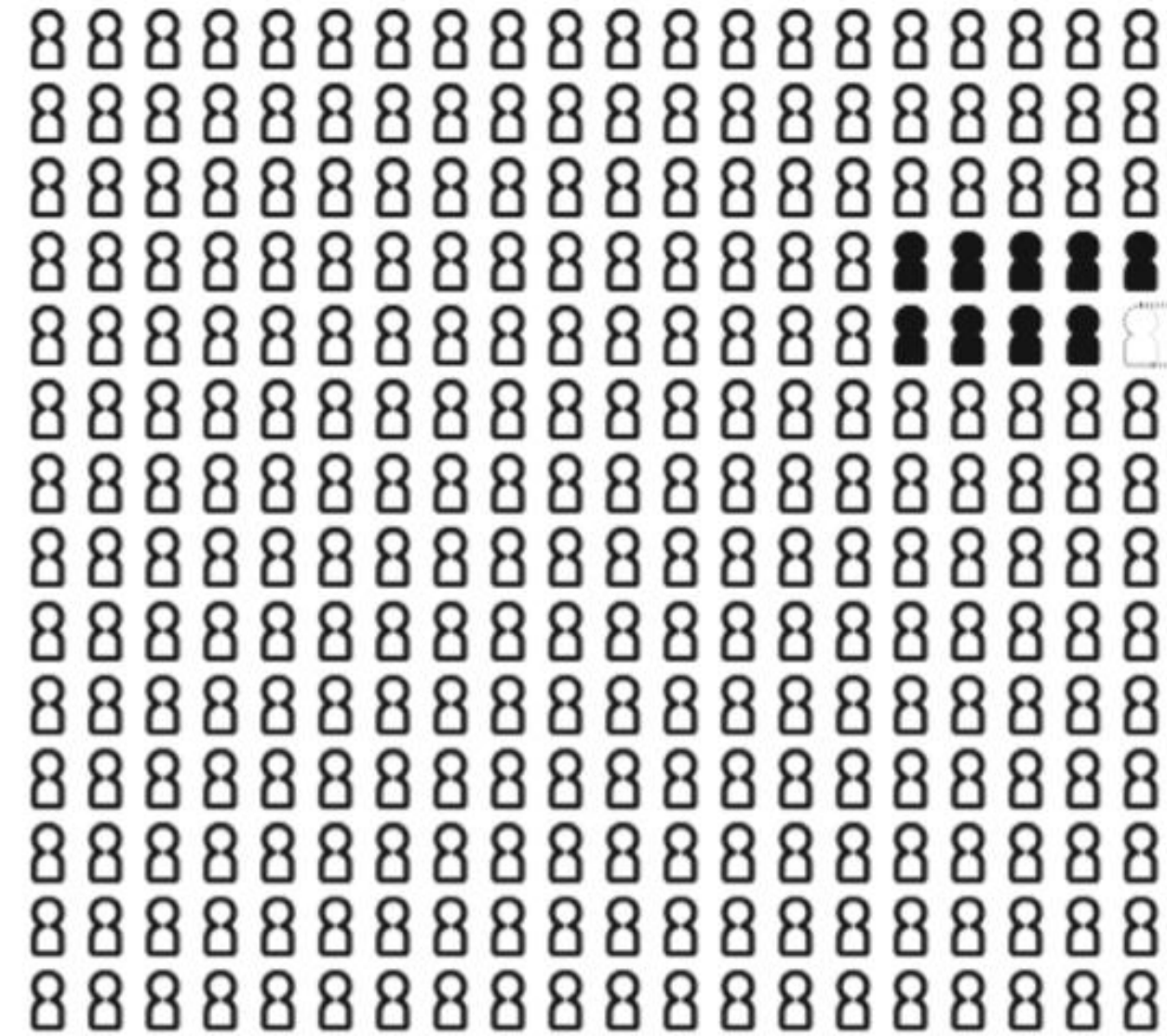
8. Low Density



3 floors
48,000 square feet

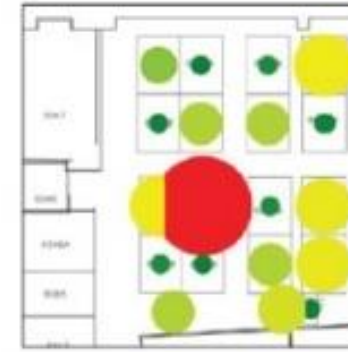


11 meeting rooms
6 multi-purpose rooms
11 phone booths



250+ people
25+ teams

Name:	John Villaggi
TEAM	
Division:	CTO
Manager:	David Lau
Size:	8
Interns:	2
PREFERENCES	
Daylight:	8.0
Acoustic:	4.0
ADJACENCIES	
Teams:	Ray Nagy Dale Locke
Amenity:	Telepresence SCRUM Fabrication Lab AR/VR Lab



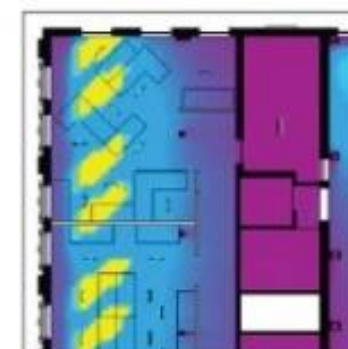
Low Distraction



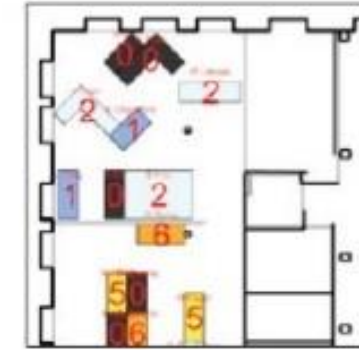
Adjacency Preference



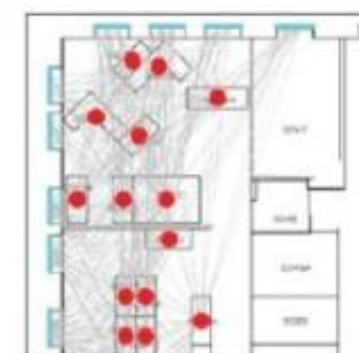
Interconnectivity



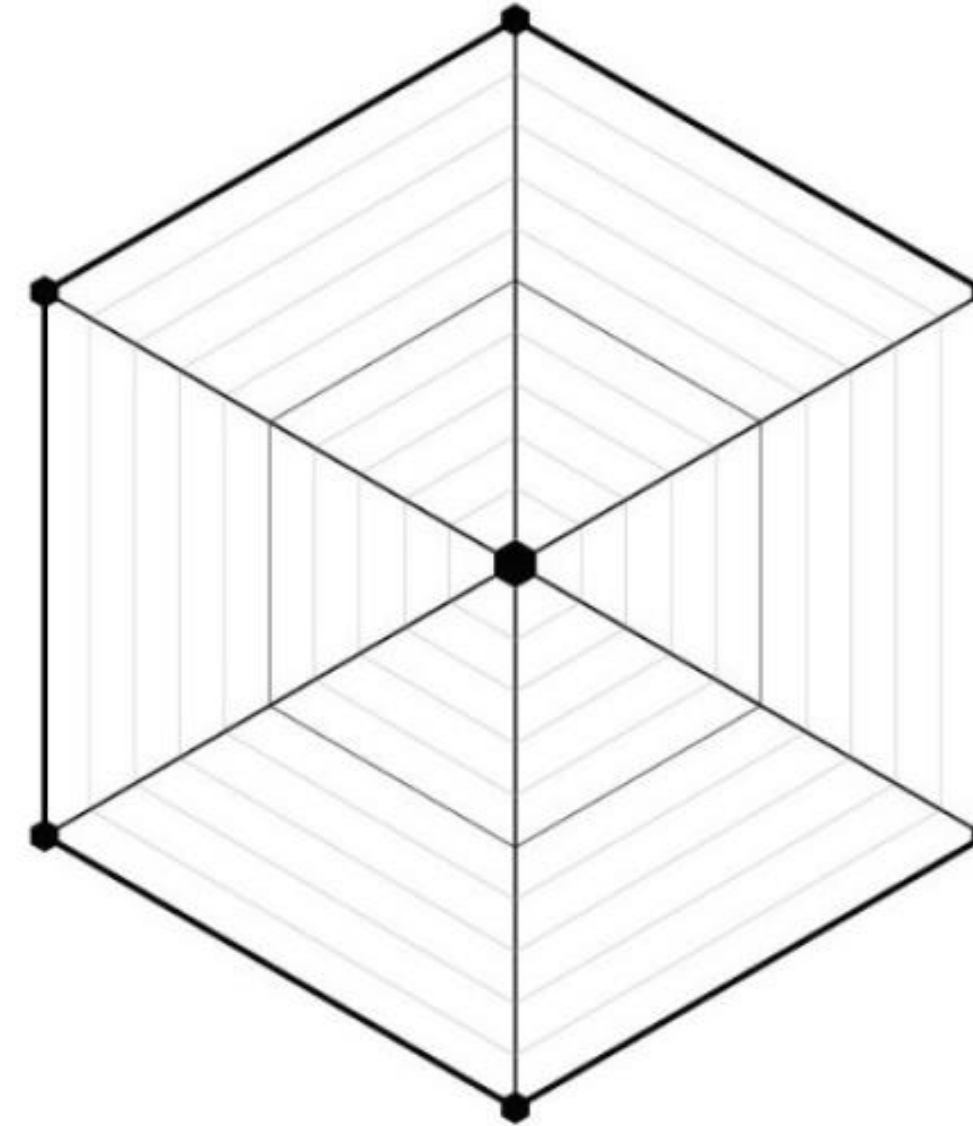
Daylight

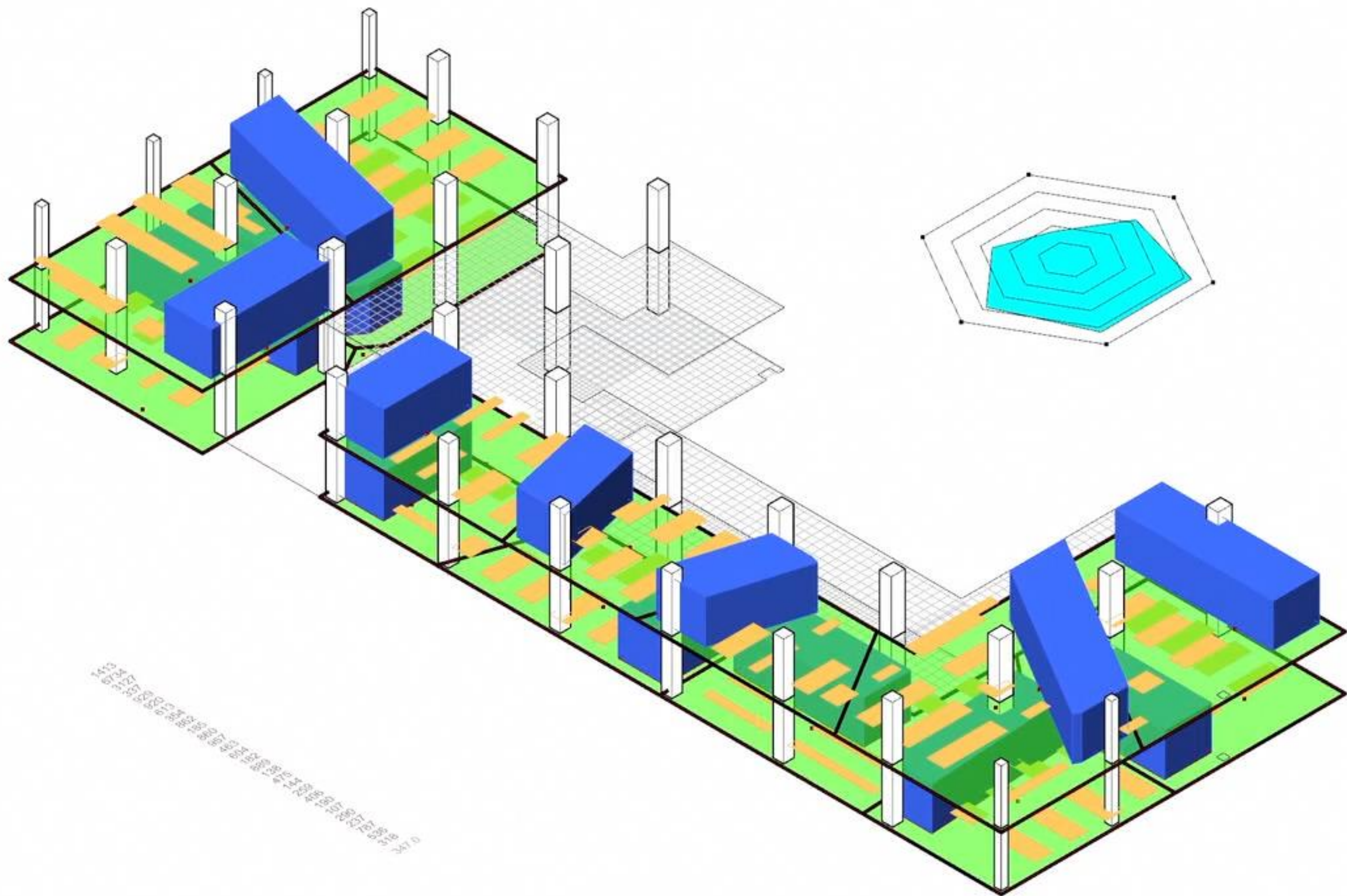


Work Style



Views to Outside







VAN WIJNEN

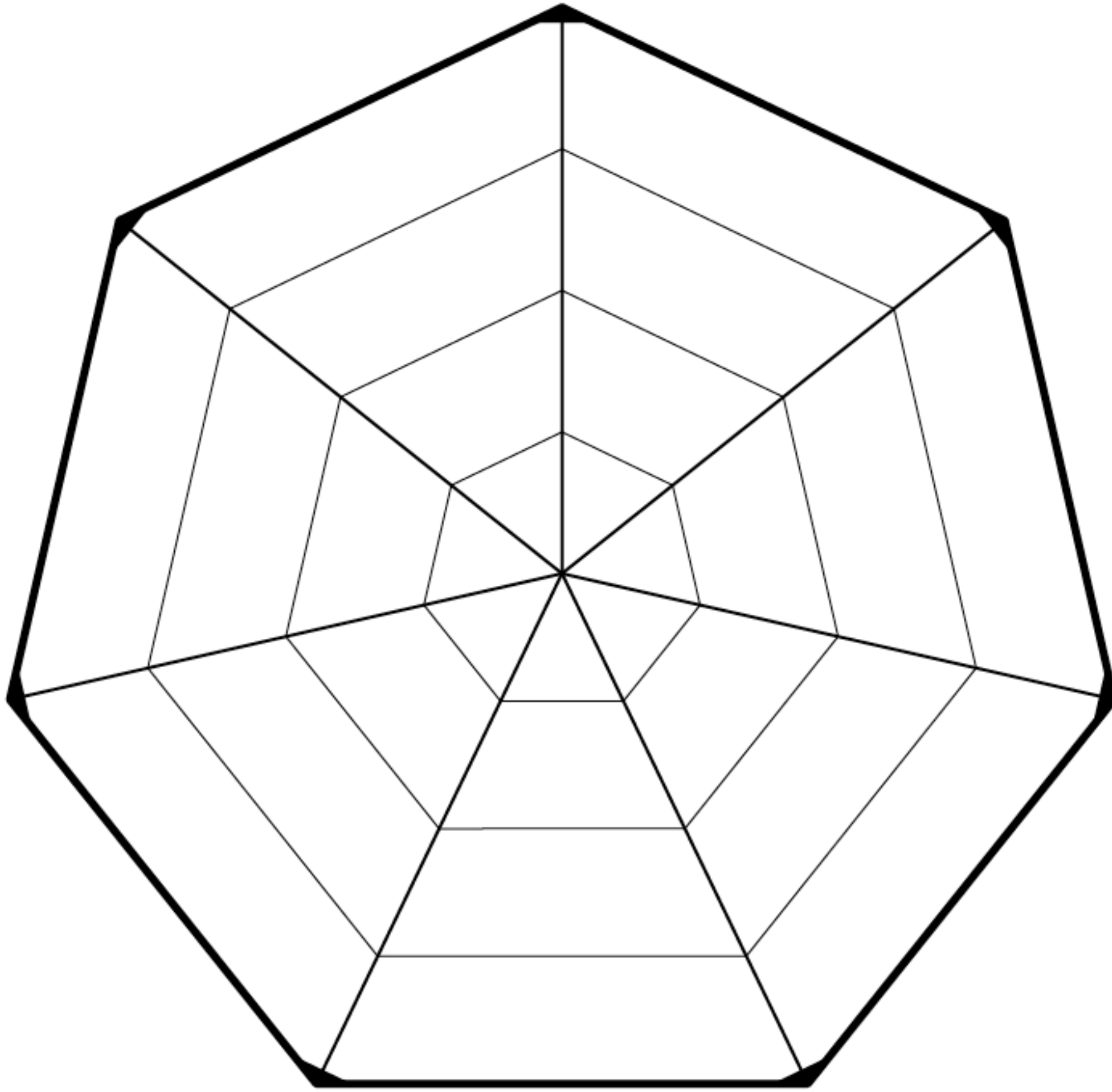
Generative Urban Design



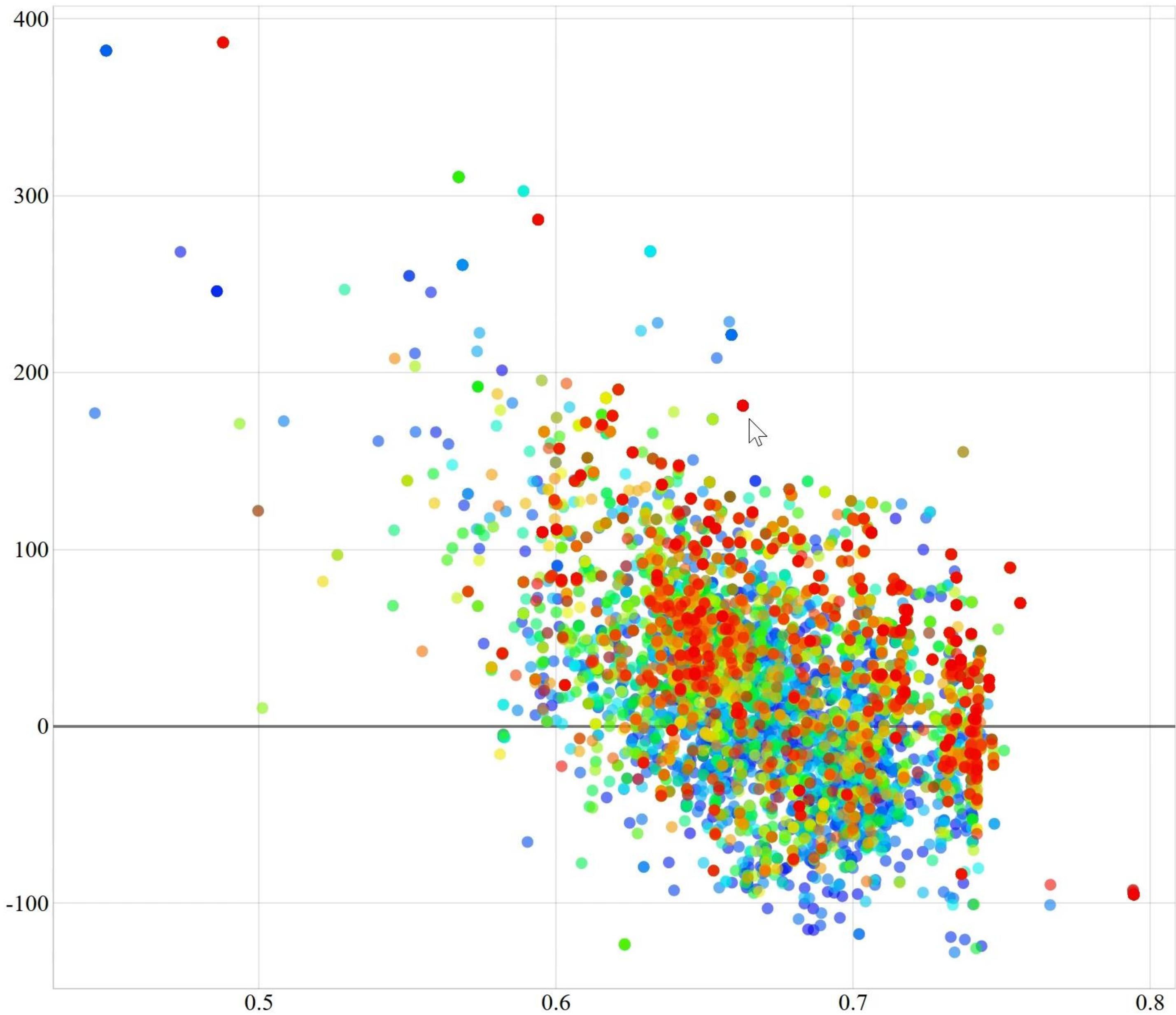


LOT BOUNDARY

PROJECT SITE







X-axis	Y-axis	Selected designs
id	id	
generation	generation	
[in] avenue	[in] avenue	
[in] street_1	[in] street_1	
[in] street_2	[in] street_2	
[in] street_3	[in] street_3	
[in] street_4	[in] street_4	
[max] solar_radiation	[max] solar_radiation	
[max] revenue	[max] revenue	

Size	Color
id	id
generation	generation
[in] avenue	[in] avenue
[in] street_1	[in] street_1
[in] street_2	[in] street_2
[in] street_3	[in] street_3
[in] street_4	[in] street_4
[max] solar_radiation	[max] solar_radiation
[max] revenue	[max] revenue

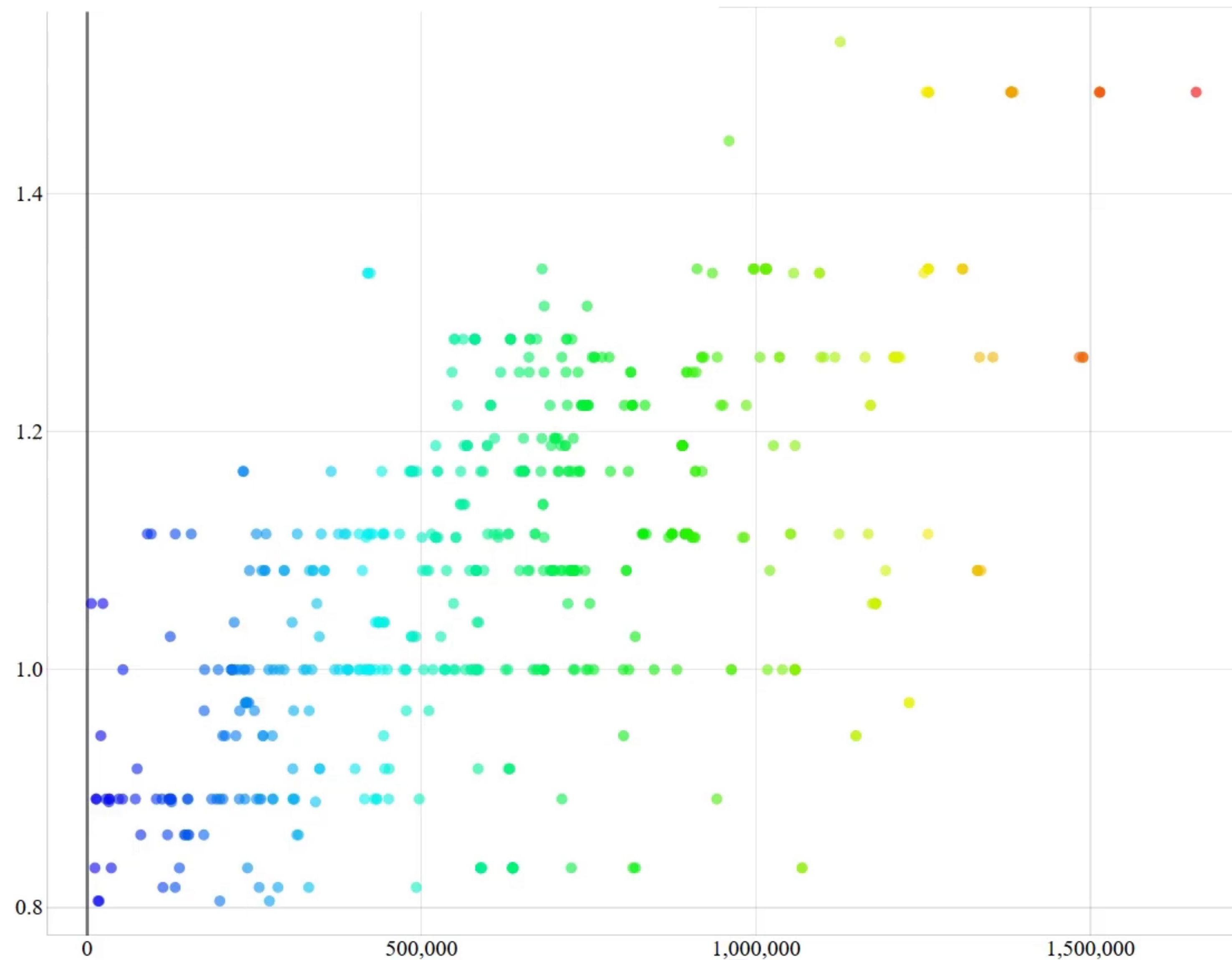
Reload data Isolate optimal designs Isolate selected designs Reset zoom

Reset

Reset

Reset

Export



Reload data

Isolate optimal designs

Isolate selected designs

Reset zoom

X-axis	Y-axis	Selected designs
id	id	
[max] solar gain	[max] solar gain	
[max] view	[max] view	
[min] variety	[min] variety	
[max] yard size	[max] yard size	
[min] total project cost	[min] total project cost	
[max] vw revenue	[max] vw revenue	
[max] program	[max] program	

Size	Color
id	id
[max] solar gain	[max] solar gain
[max] view	[max] view
[min] variety	[min] variety
[max] yard size	[max] yard size
[min] total project cost	[min] total project cost
[max] vw revenue	[max] vw revenue
[max] program	[max] program

Reset

Reset

Reset

Export

Generative Design

mit Dynamo & Project Refinery

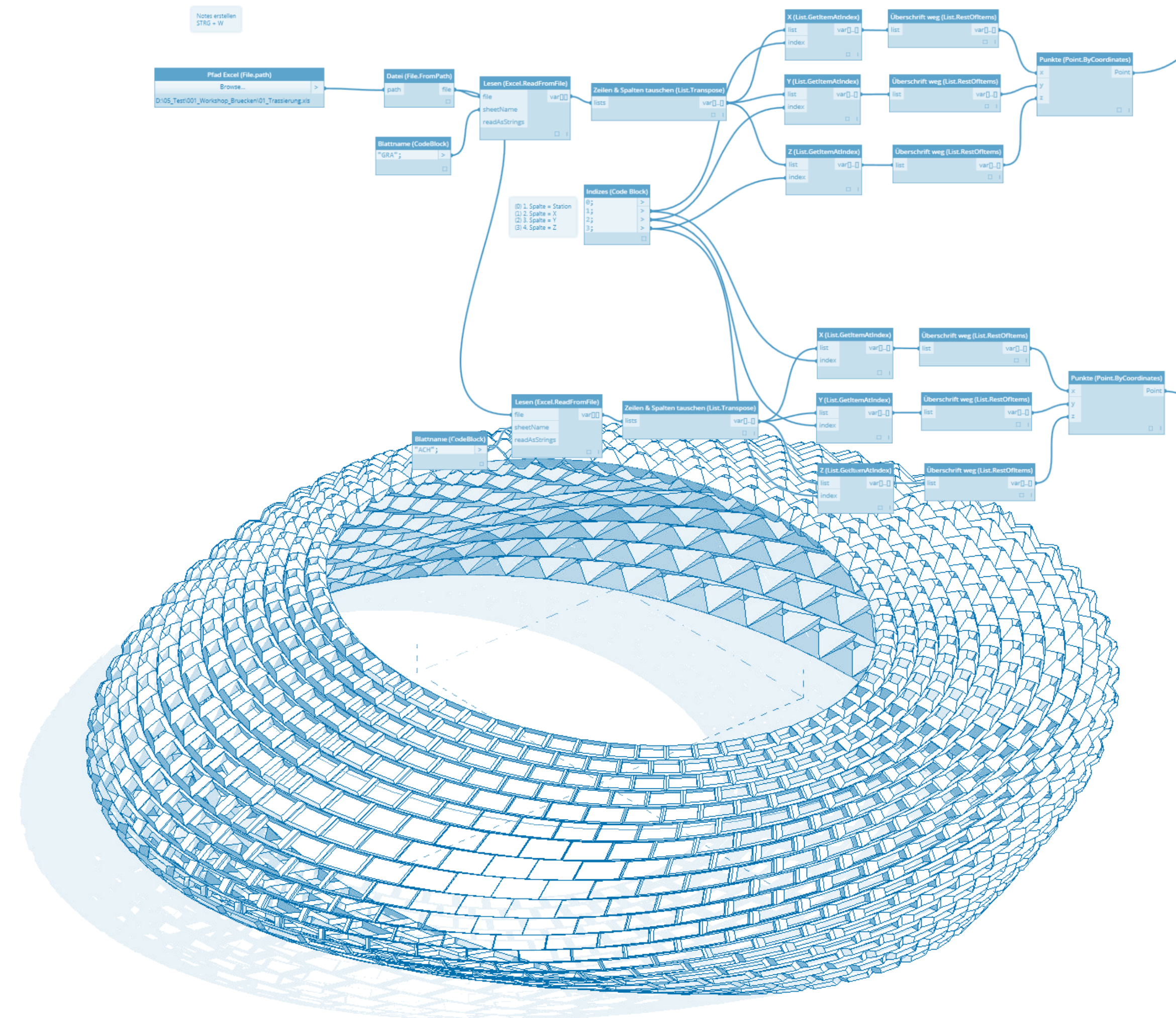


Dynamo

Visual Scripting Lösung von Autodesk

dynamobim.org

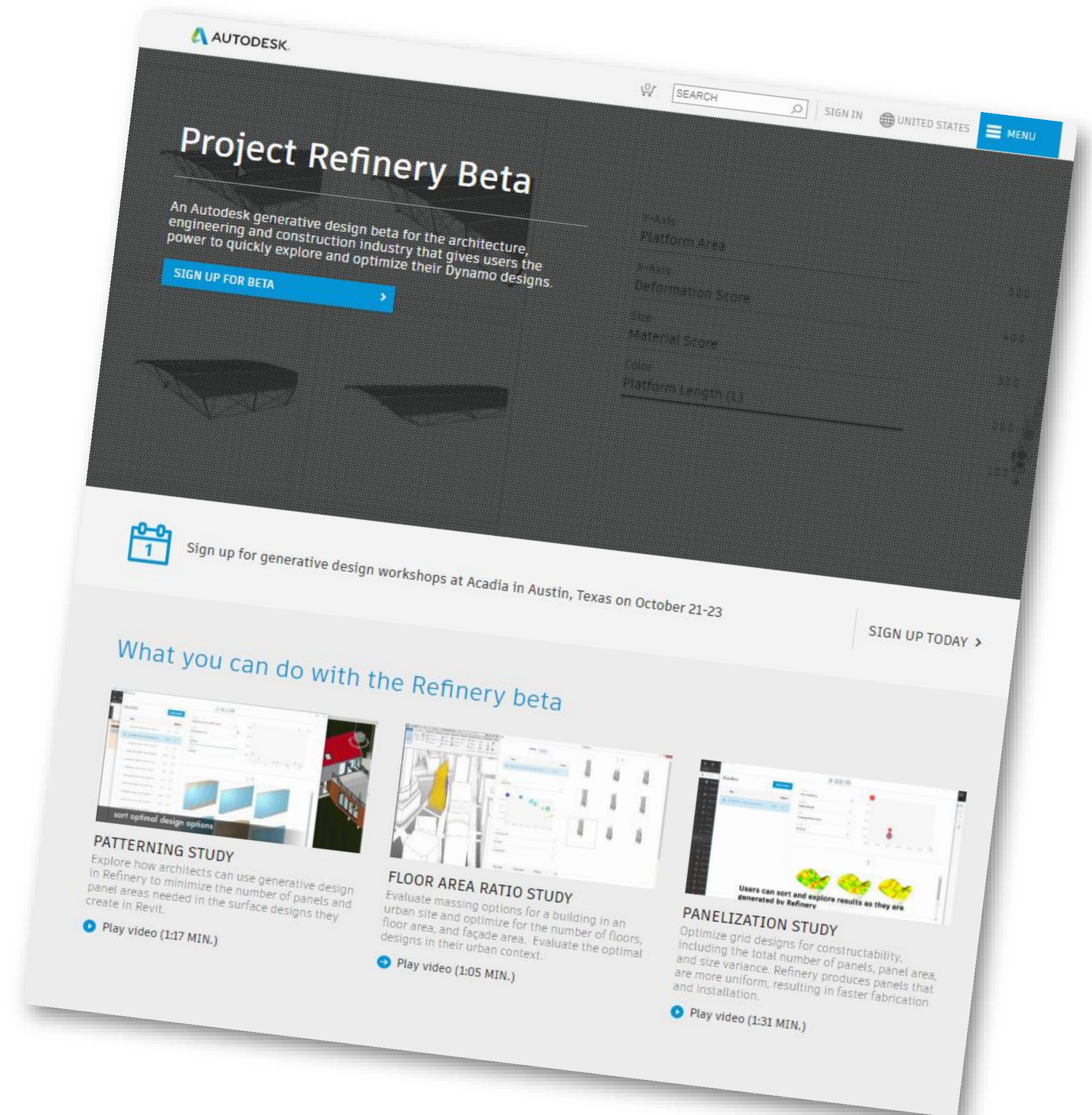
- Computerbasiertes Entwerfen mit direkter Anbindung an Revit
- Zugriff auf alle Daten in Revit, inklusive Import/Export Möglichkeiten
- Automatisierung durch Zugriff auf die Revit Programmierschnittstelle
- **Generative Design mit Refinery**



Project Refinery (Public Beta)

www.autodesk.com/solutions/refinery-beta

- Entwurfsanalyse und Optimierung basierend auf dem NSGA-II Algorithmus
https://www.iitk.ac.in/kangal/Deb_NSGA-II.pdf
- Umfangreiche Analyseansichten
- Übernahme der gewählten Option nach Dynamo





★ Learn More

Refinery Demos

Getting Started

Learning Resources

Refinery Sample Files

💬 Give Feedback

Questions & Feedback

Submit

📖 Resources

Legal Agreements

FAQs

Download Refinery



Download Sample Files



Project Refinery

Design Exploration for Dynamo

Overview

Resources

My To-Do

Following

About

Welcome to Project Refinery, Lejla!

The Autodesk Refinery team is developing software to help you perform design exploration including optioneering and optimization workflows on your Dynamo projects. Here, you will be able to download Refinery, test functionality, report any issues, post questions, comments, and feature requests to help improve the offering before release to a wider audience. Please use the [Getting Started](#) link for information on the latest Refinery resources. Try Refinery, and start giving feedback!

Thank you for working with us to improve Refinery!

Feedback Overview

Type

Feedback

Comments



Questions & Feedback

254

854

Leave Project

Leave this project

Vorgaben in Dynamo

VARIABLEN

Integer Slider

37

Min 0

Max 100

Step 1

Number Slider

0.6

Min 0

Max 1

Step 0.1

FIXE VORGABEN

Number

0.000

REFINERY

44.7

- Entfernen
- Gruppe erstellen
- Aus Gruppe entfernen
- Zu Gruppe hinzufügen
- Anhalten
- ☒ Vorschau
- Bezeichnungen anzeigen
- Block umbenennen...
- ☒ Ist Eingabe
- Ist Ausgabe
- Hilfe...

Dynamo

DateiBearbeitenAnsichtPaketeEinstellungenHilfeRefineryData Shapes

Library

02-3BoxVolumeSurfaceArea

Search...

Math

Revit

Script

String

Add-ons

Archi-Lab_Grimshaw

Archilab

Bakery

BimorphNodes

Clockwork

Data-Shapes

DynaMaps

DynamoText

DynaShape

LunchBox

Refinery

Rhythm

Slingshot

SpaceAnalysis

Springs

SteamNodes

WombatDynamo

Launch Refinery

Export for Refinery...

3BOX VOLUME SURFACE AREA
Refinery Graph Example

Input: Changeable variables

Geometry [Dynamo]: Geometry Manipulation

Analysis: Surface Area and Volume

Output: Output information that can be used to filter results in Refinery

Visualization: Colourizes Dynamo geometry in the Background Preview window

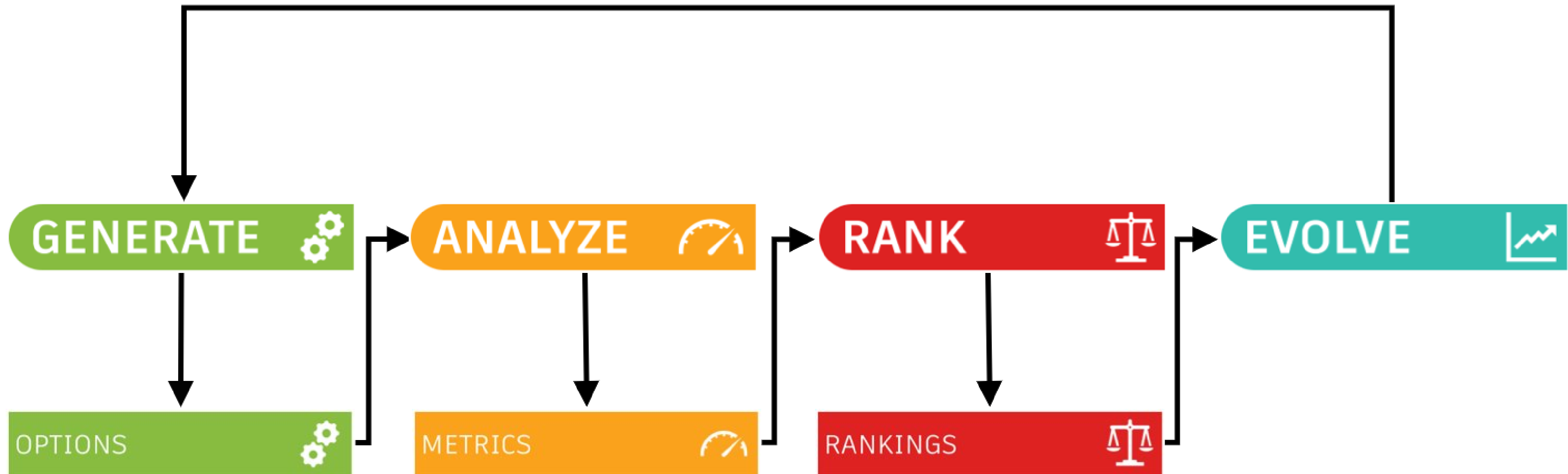
3D visualization of three stacked rectangular prisms (boxes) of increasing size, rendered in a light blue/teal color.

Manuell

Ausführen

Ausführung abgeschlossen

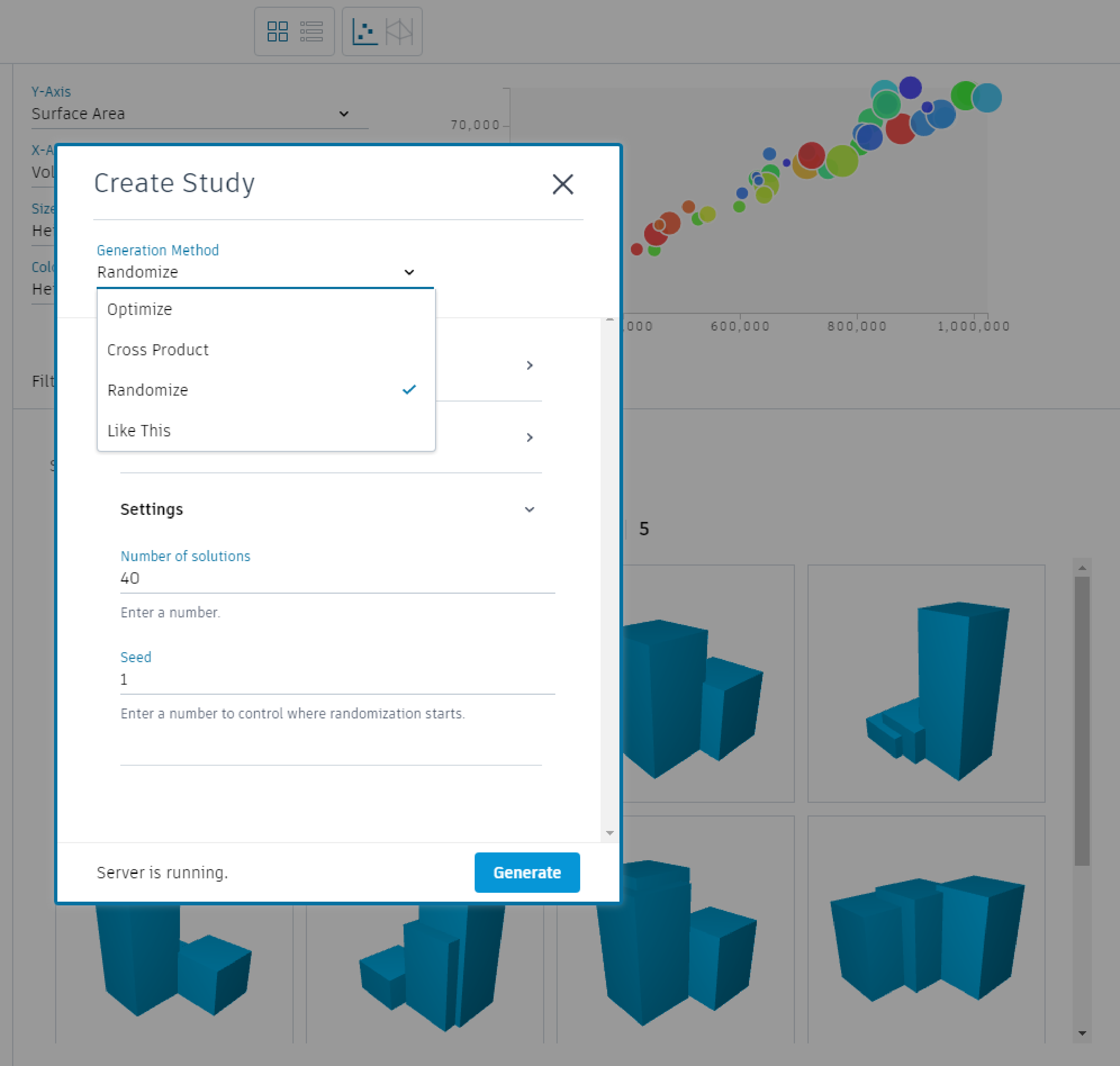
Generative Design Methode



GENERATE

Refinery Generation Methods

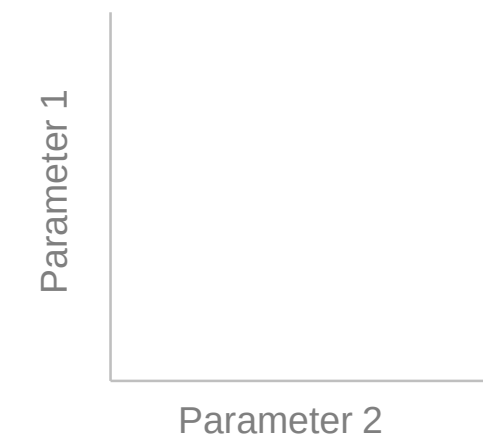
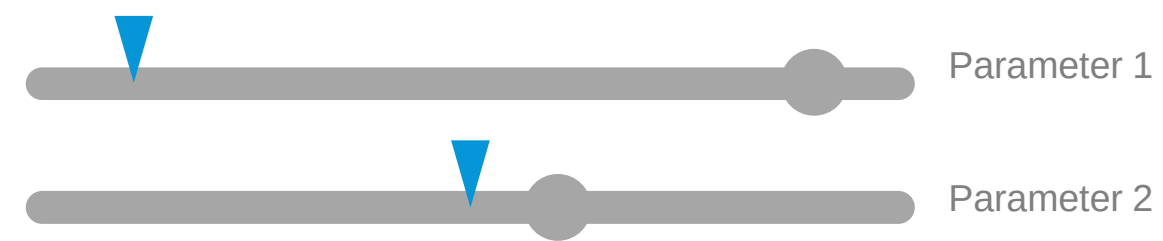
- 1. Optimize
- 2. Cross Product
- 3. Randomize
- 4. Like This



GENERATE 

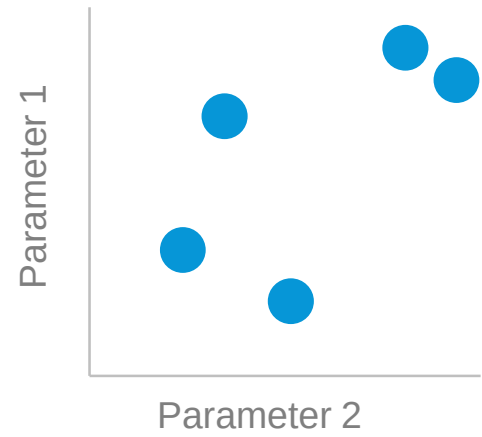
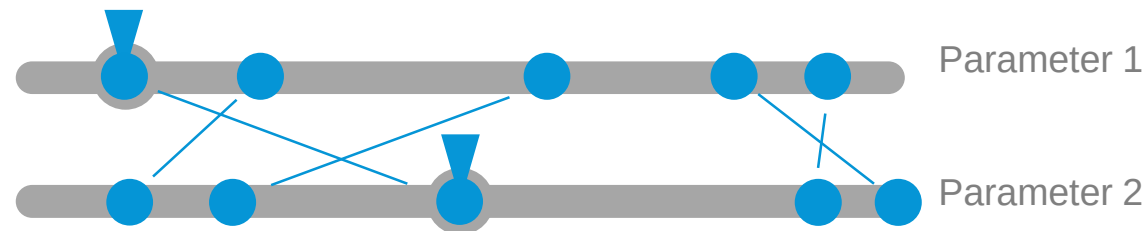
Refinery Methoden

RANDOMIZE



Refinery Methoden

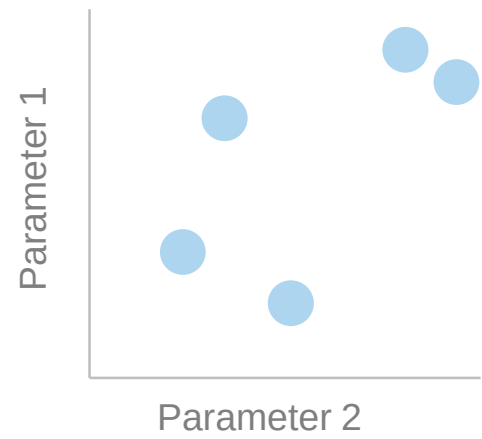
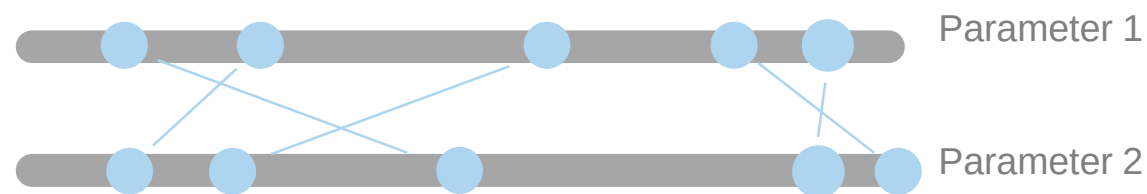
RANDOMIZE



5 DESIGNS
defined by user

Refinery Methoden

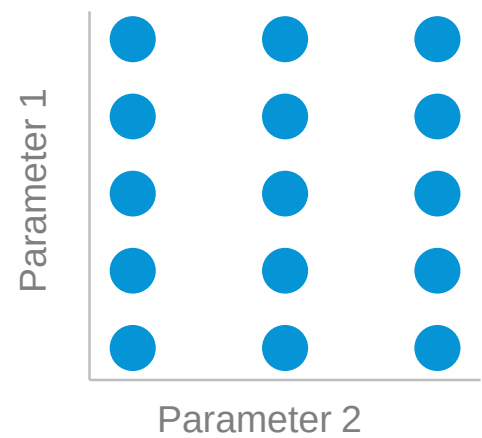
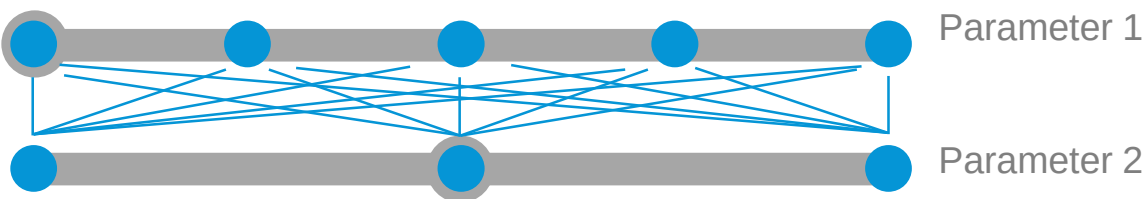
RANDOMIZE



5 DESIGNS
defined by user

CROSS PRODUCT

5x
3x

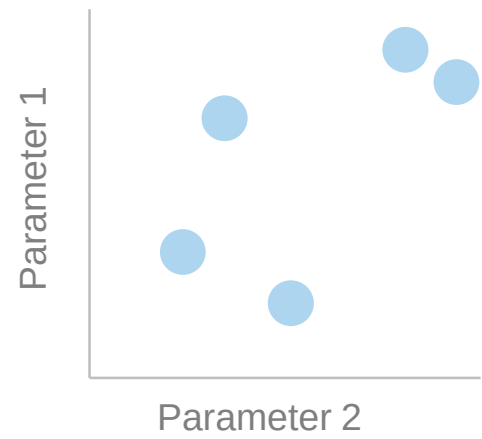
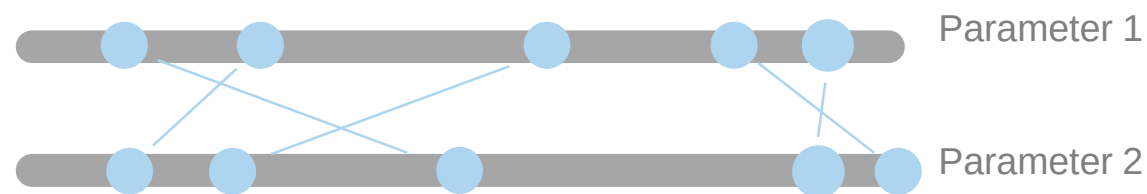


5 x 3 = 15 DESIGNS
user defines sampling density

GENERATE

Refinery Methoden

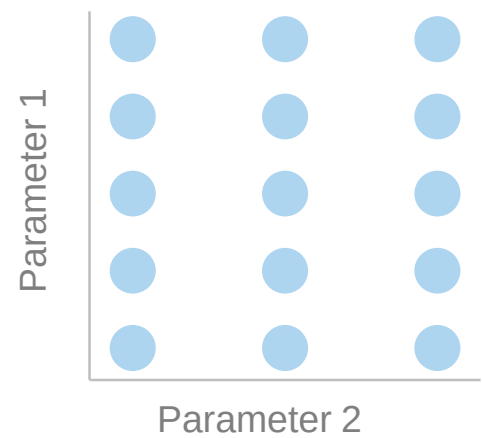
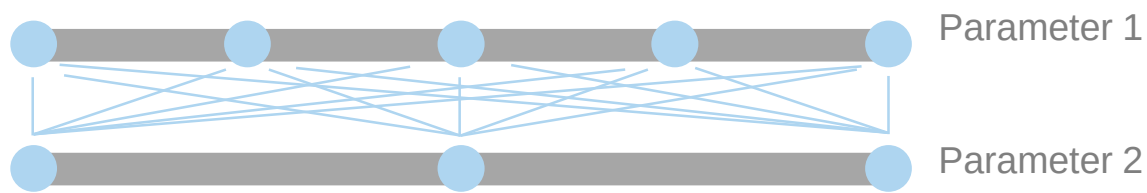
RANDOMIZE



5 DESIGNS
defined by user

CROSS PRODUCT

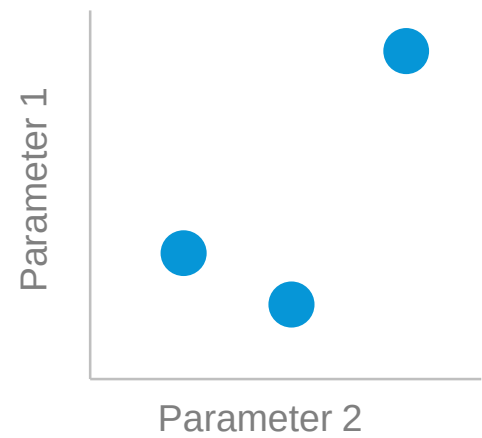
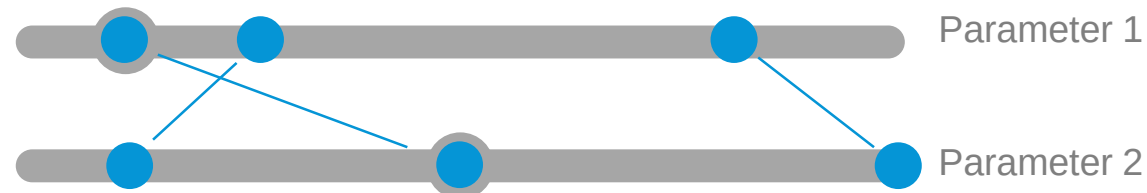
5x
3x



5 x 3 = 15 DESIGNS
user defines sampling density

OPTIMIZE

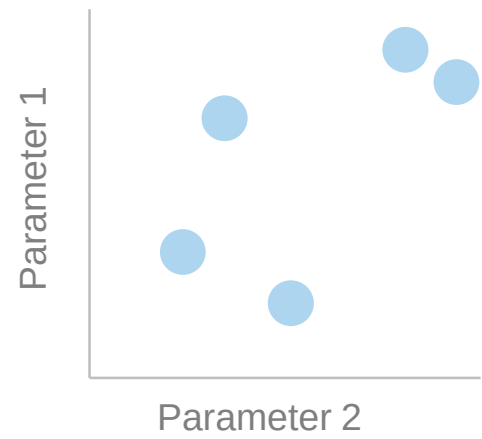
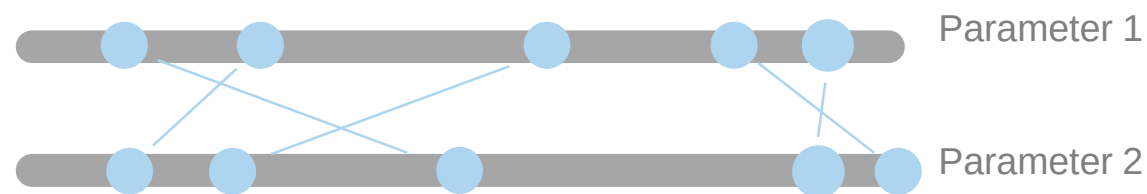
generation 1 population of 3



GENERATE

Refinery Methoden

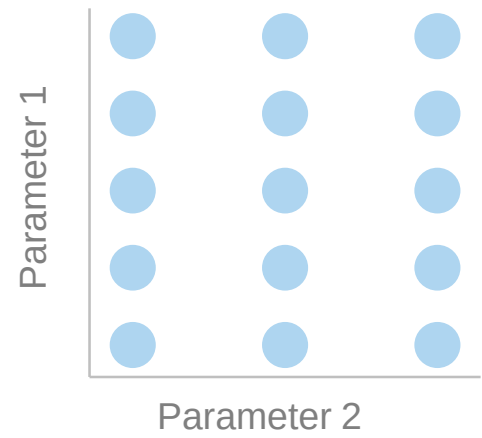
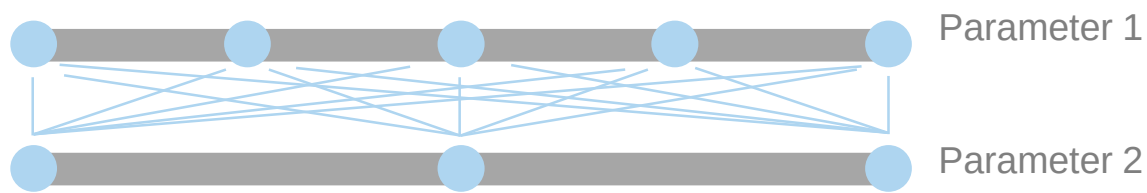
RANDOMIZE



5 DESIGNS
defined by user

CROSS PRODUCT

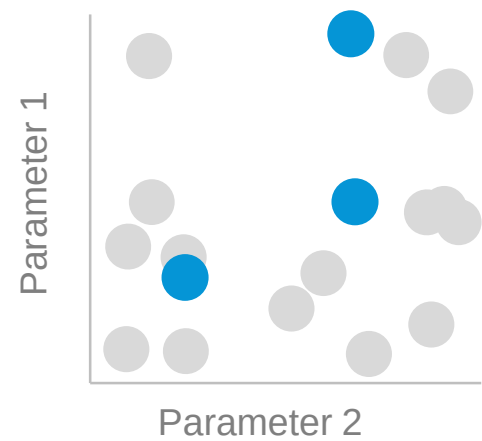
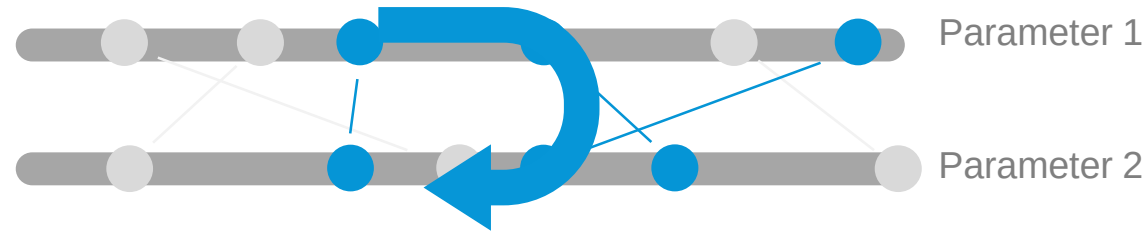
5x
3x



5 x 3 = 15 DESIGNS
user defines sampling density

OPTIMIZE

generation 1 population of 3
generation 2 population of 3
...
generation 6 population of 3

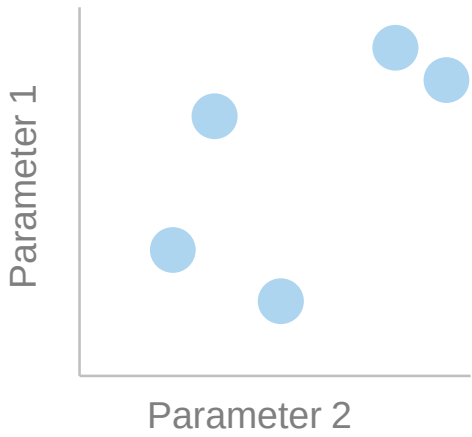
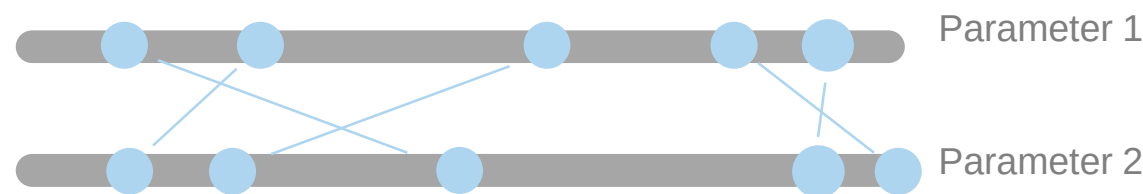


3 x 6 = 18 DESIGNS
user defines population size
and number of generations

GENERATE

Refinery Methoden

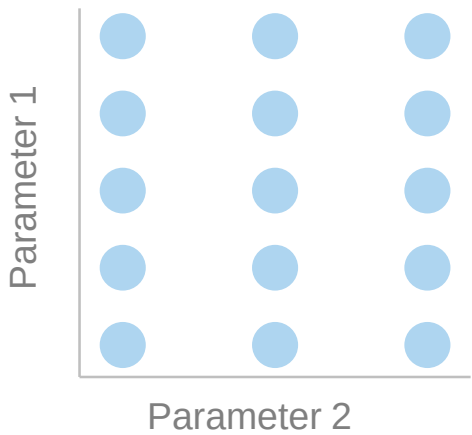
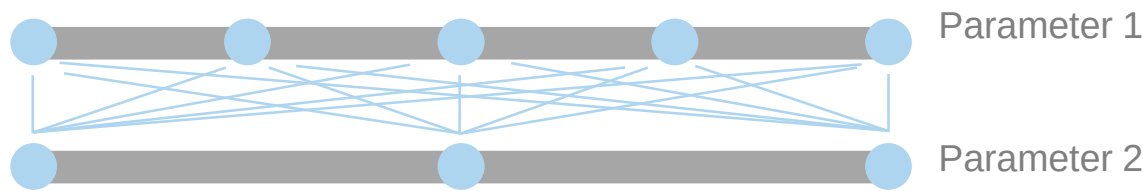
RANDOMIZE



5 DESIGNS
defined by user

CROSS PRODUCT

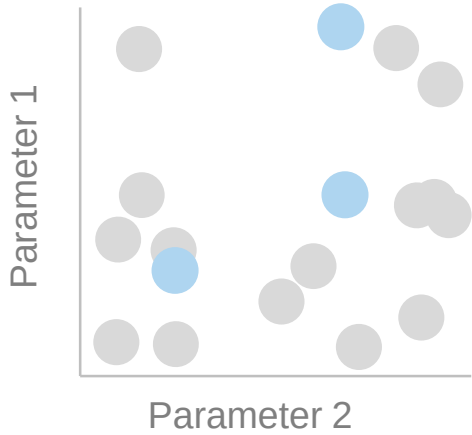
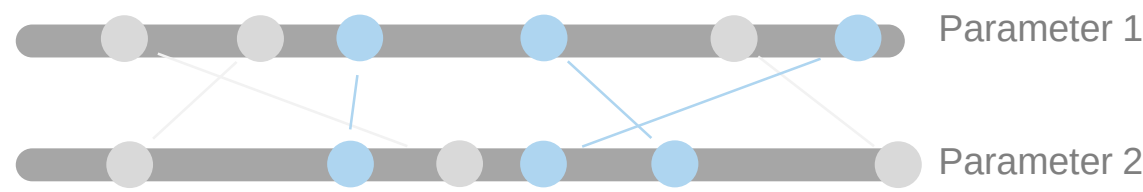
5x
3x



5 x 3 = 15 DESIGNS
user defines sampling density

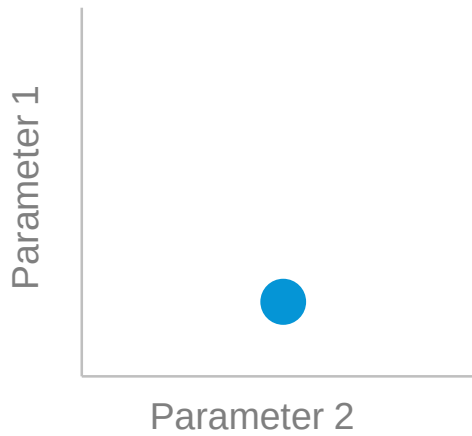
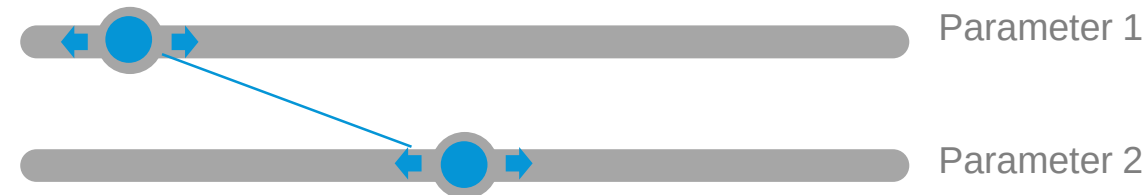
OPTIMIZE

generation 1 population of 3
generation 2 population of 3
...
generation 6 population of 3



3 x 6 = 18 DESIGNS
user defines population size and number of generations

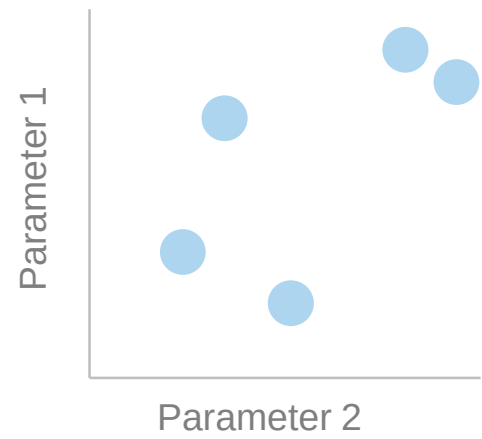
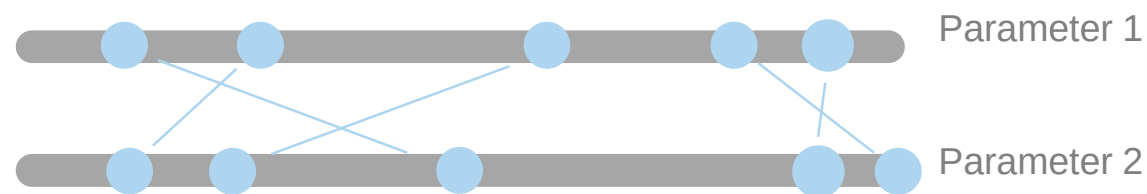
LIKE THIS



GENERATE

Refinery Methoden

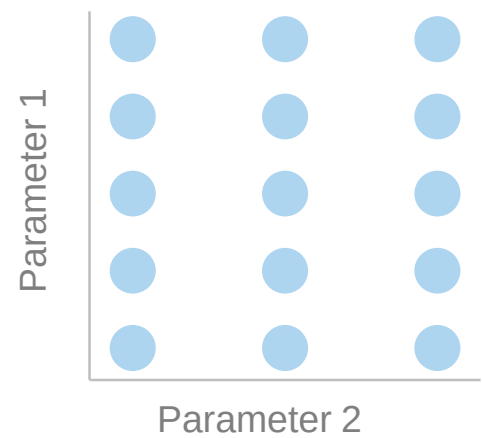
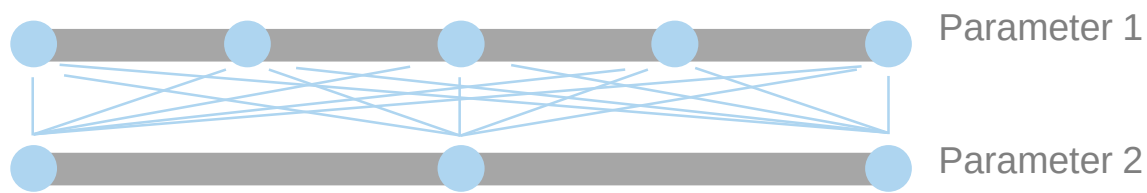
RANDOMIZE



5 DESIGNS
defined by user

CROSS PRODUCT

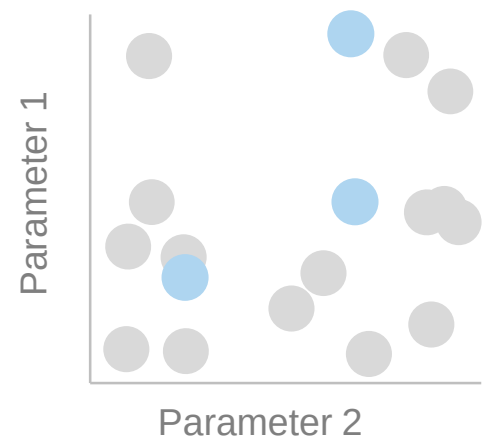
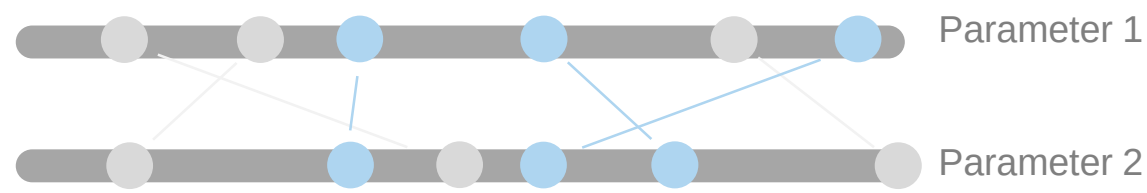
5x
3x



5 x 3 = 15 DESIGNS
user defines sampling density

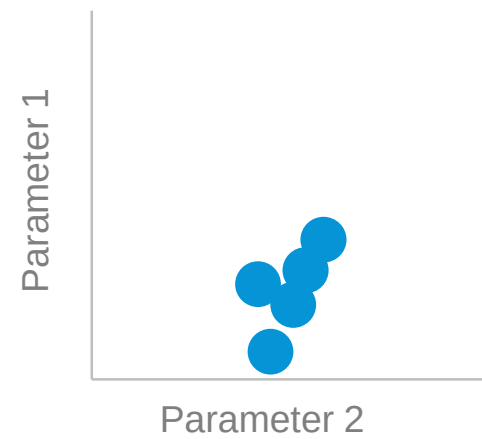
OPTIMIZE

generation 1 population of 3
generation 2 population of 3
...
generation 6 population of 3



3 x 6 = 18 DESIGNS
user defines population size and number of generations

LIKE THIS

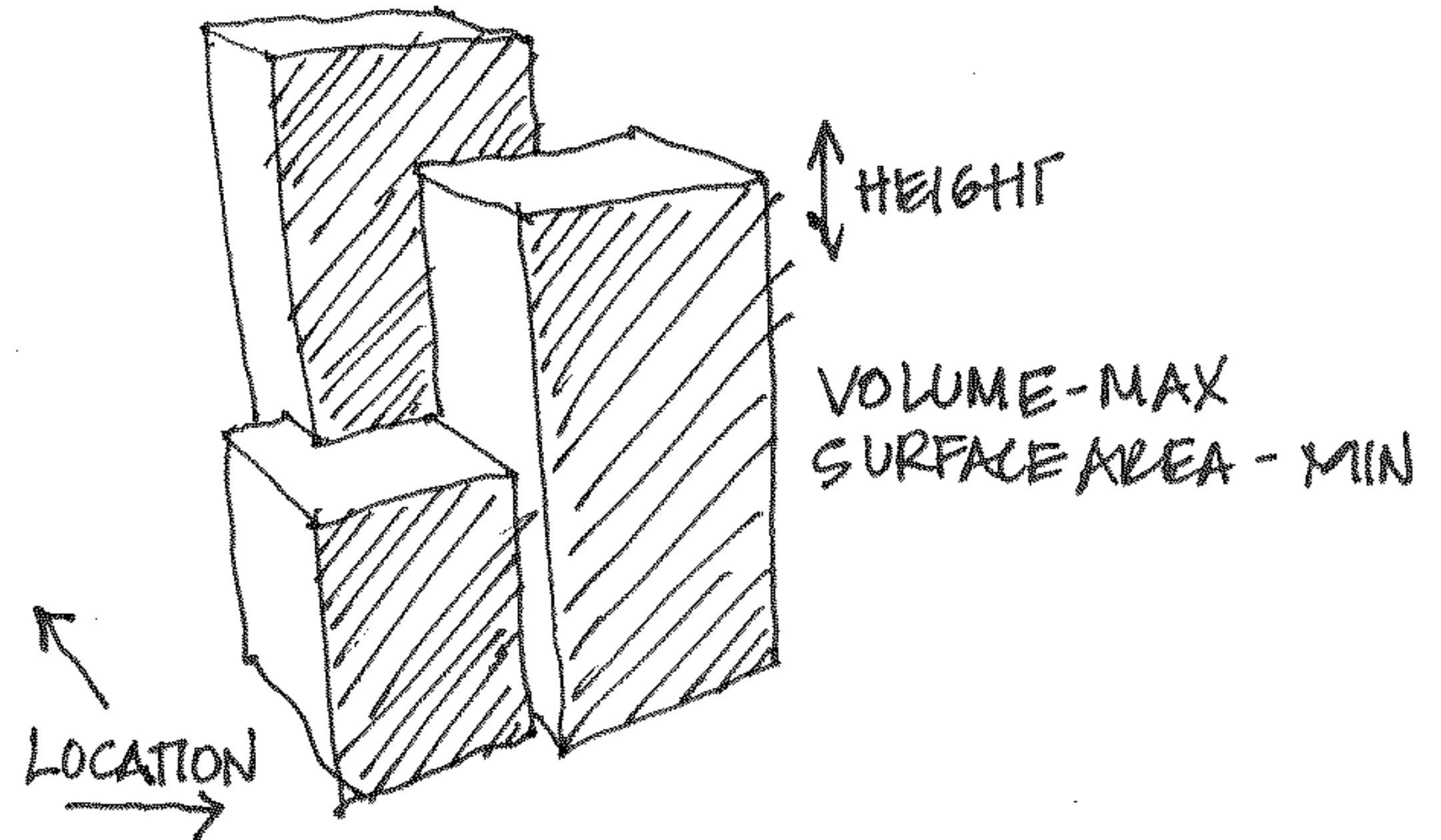


5 DESIGNS
defined by user

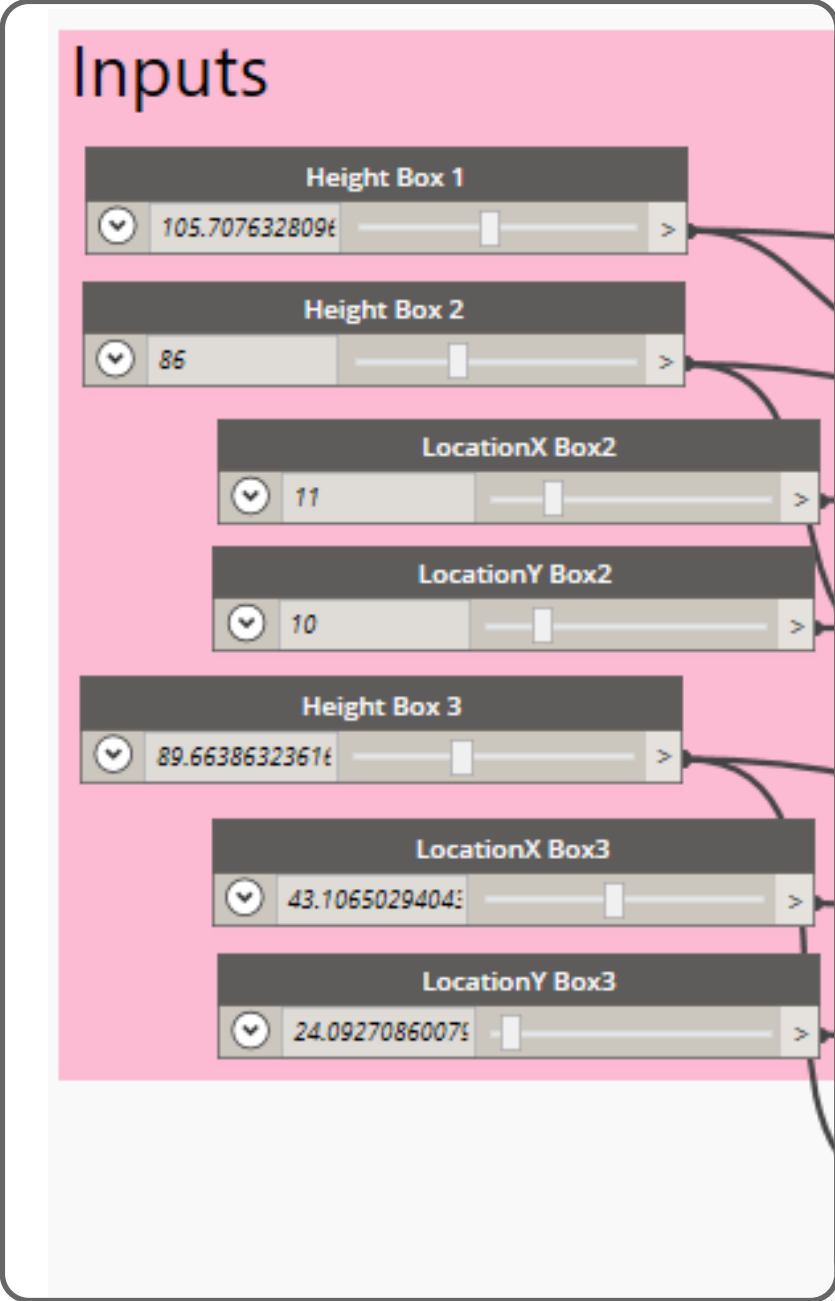
Beispiel Massenstudie

Massenstudio zur Ermittlung des idealen Verhältnisses zwischen Außenfläche und Volumen

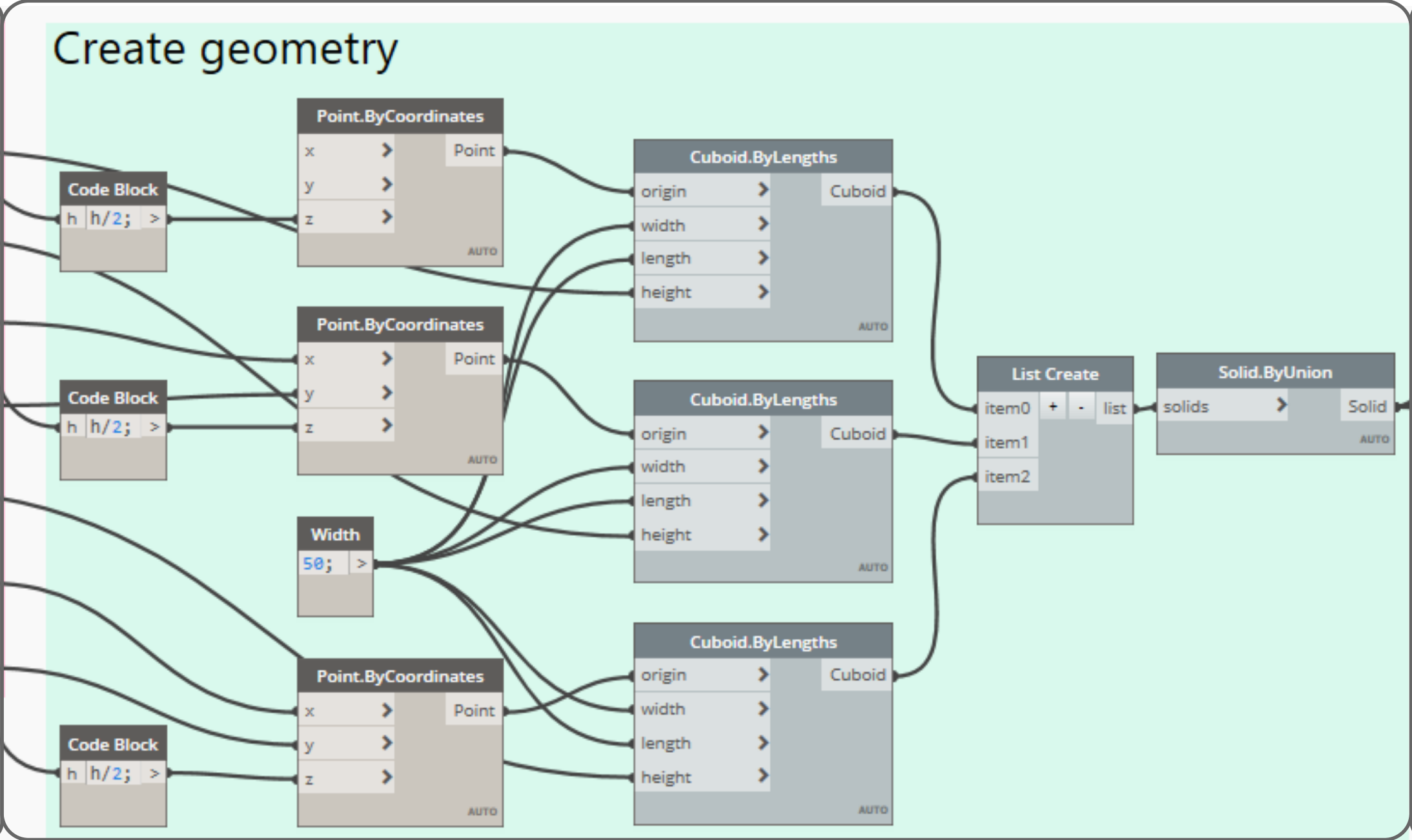
- Vorgabe
 - 3 Körper
- Variablen
 - Lage von 2 der 3 Körper
 - Höhe alle drei Körper
- Ziele
 1. Maximales Volumen (BGF)
 2. Minimale Außenfläche (Reduktion der Fassadenkosten)



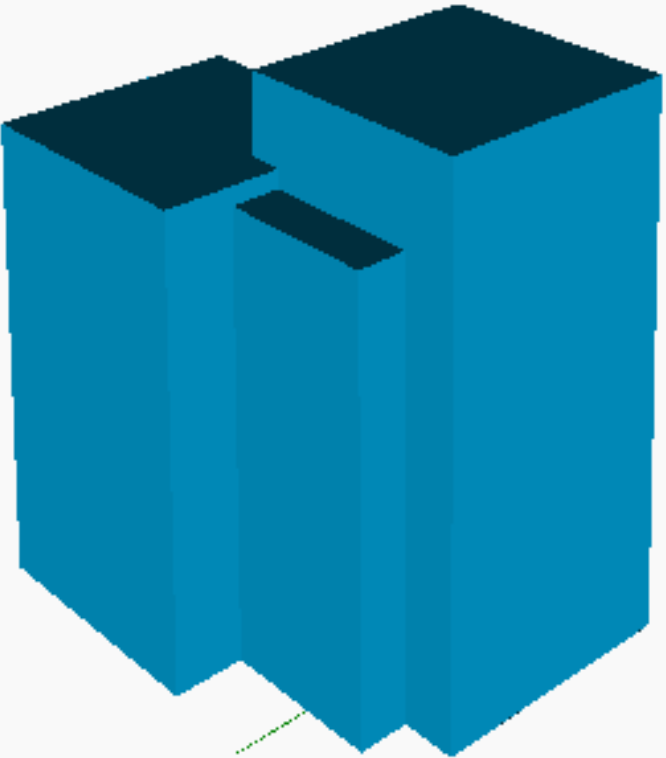
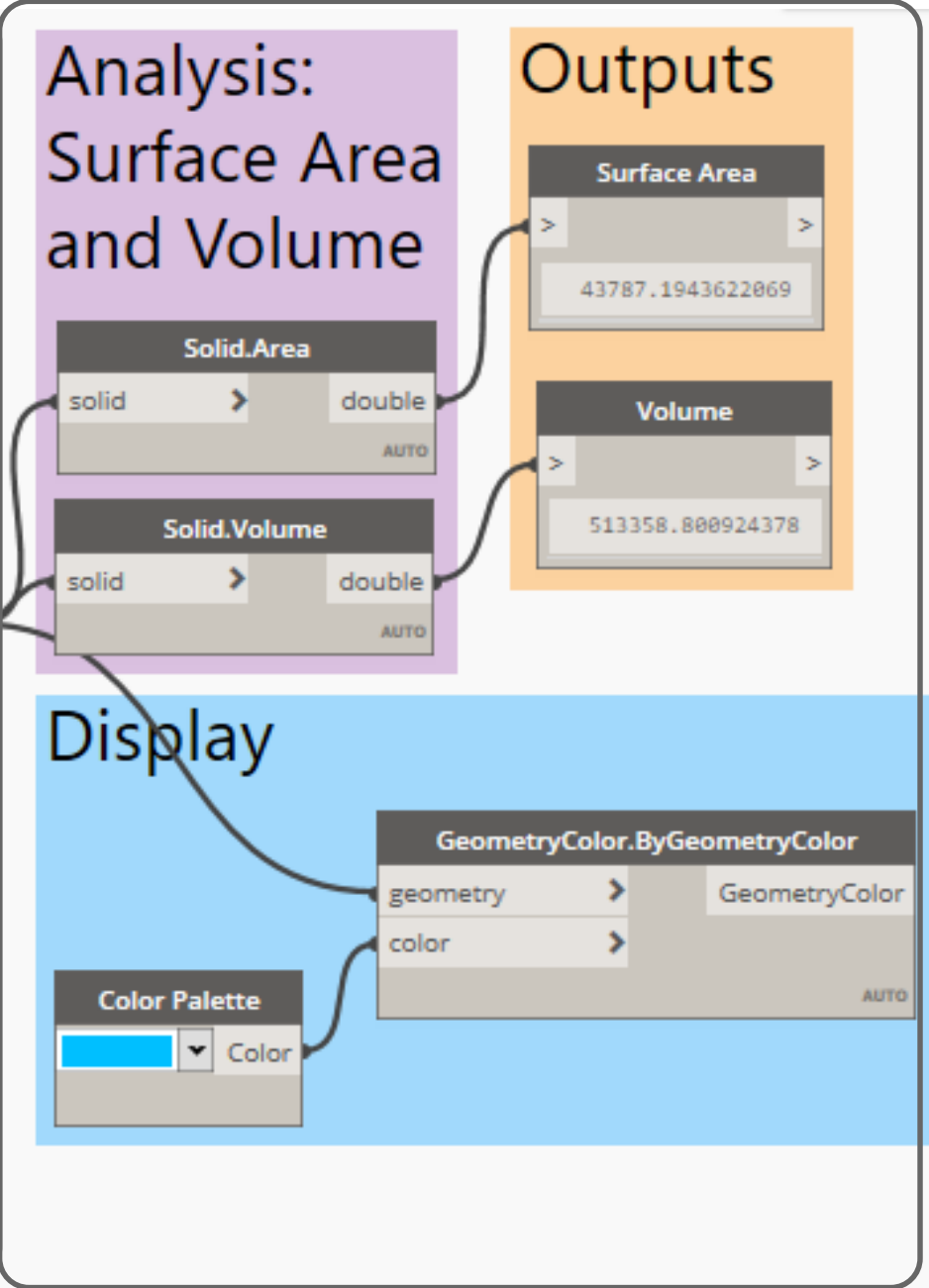
INPUTS

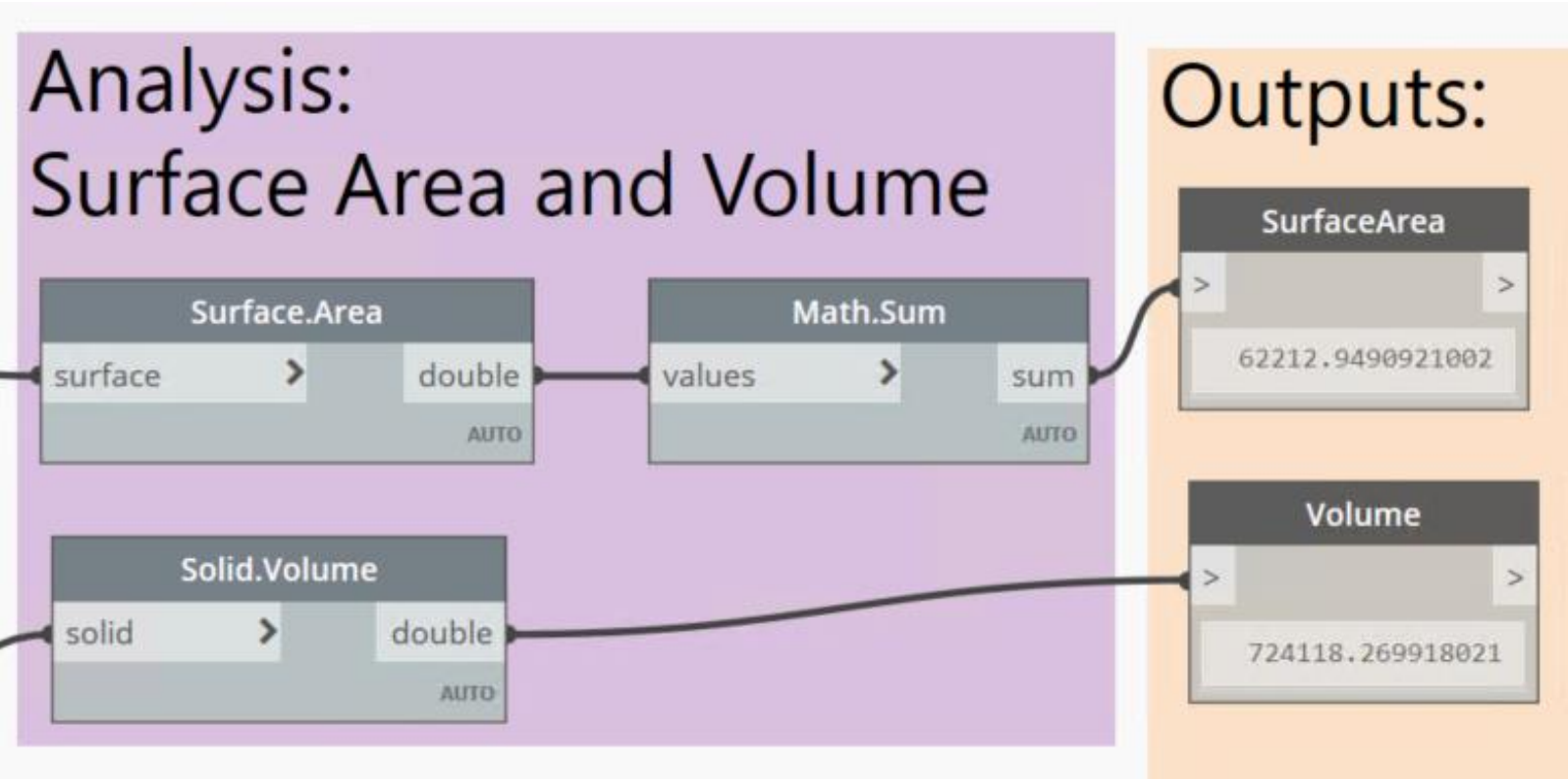


GEOMETRIE

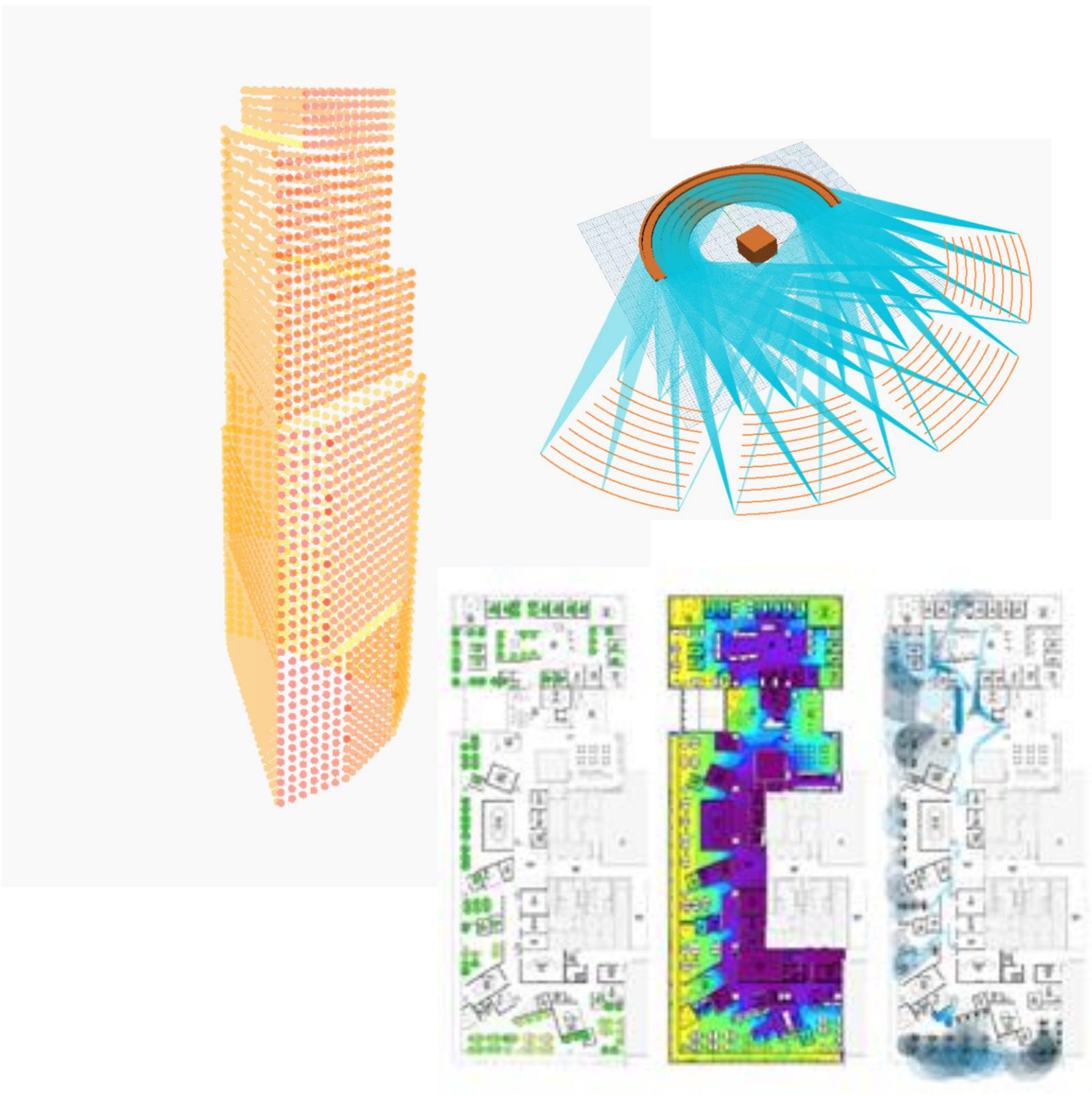


AUSWERTUNG

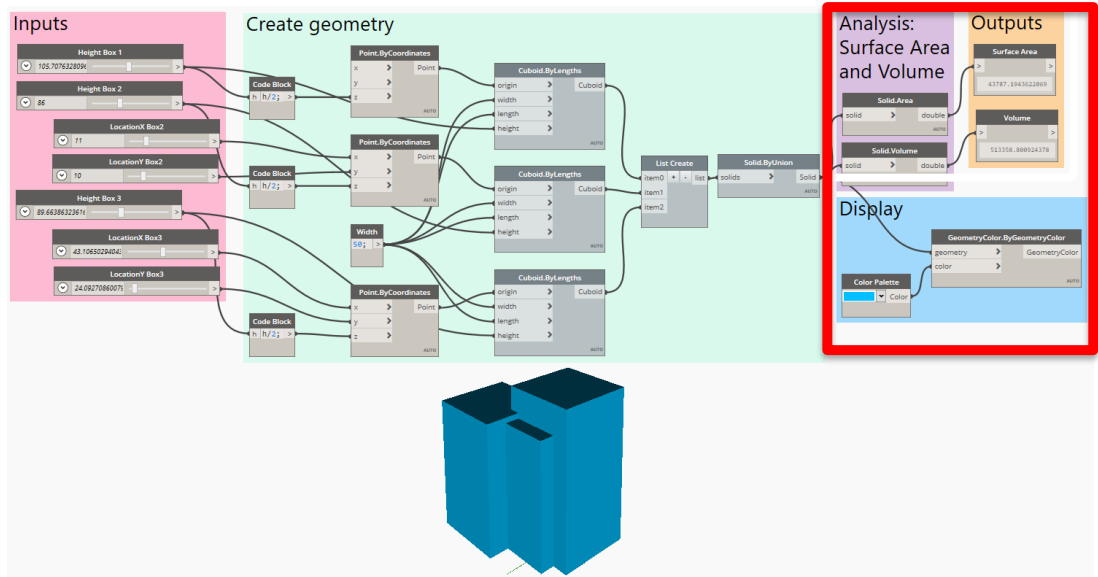




EINFACHE
BERECHNUNGEN



SIMULATIONEN



Dynamo

File Edit View Packages Settings Help

3BoxVolumeSurfaceArea_AddDetail_Se

Library

Analysis: Surface Area and Volume

Solid.Area

solid double AUTO

Solid.Volume

solid double AUTO

Outputs

Surface Area

> 46812.3649698652 >

Volume

> 5259 >

Remove

Create Group

Remove from Group

Add To Group

Freeze

Preview

Show Labels

Rename Node...

☒ Is Output

Help...

Show Raw Data

Automatic

Run completed with warnings.

3D Viewport

3D Model

Refinery

Studies

New Study

Study		
☐	2a2d3aae-da52-4e20-a165-7	10/10
☐	1b7b28c2-29fe-4f01-a411-4b	10/10
☐	436578e4-b3e3-4e34-b019-!	40/40
☐	90c1699a-4b6c-4e6e-ba7d-1	10/10
☒	7c8d4a3a-c9c3-4f23-b97e-b:	40/40

Sort by SurfaceArea

↑

1

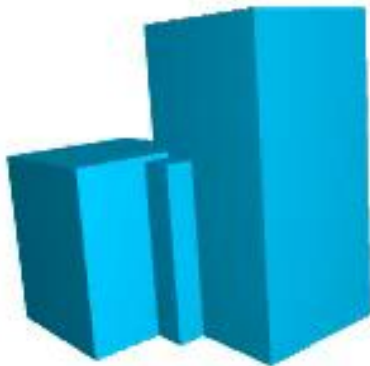
2

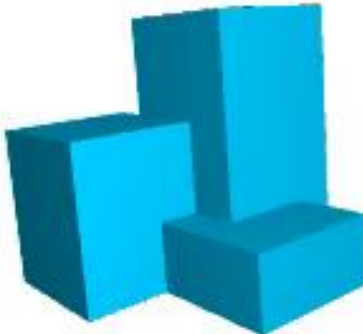
3

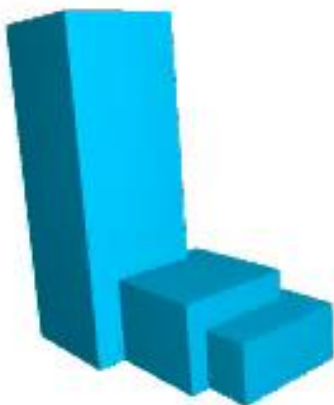
4

5



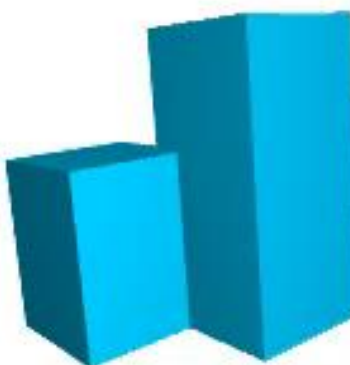


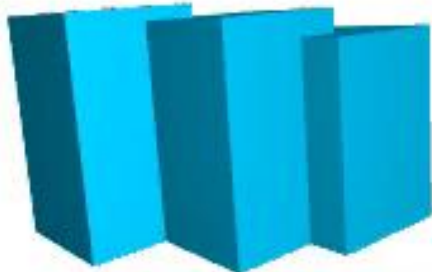


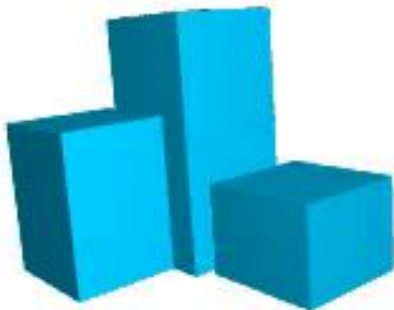












EVOLVE



Einstellungsmöglichkeiten:

- Output goals
- Population size
- Generation size
- Seed

Create Study

Generation Method

Optimize

Outputs

SurfaceArea

50115.004533...

MINIMIZE

Volume

669808.59405..

MAXIMIZE

Settings

Population Size

100

Enter a number that is a multiple of 4.

Generations

100

Enter a number.

Seed

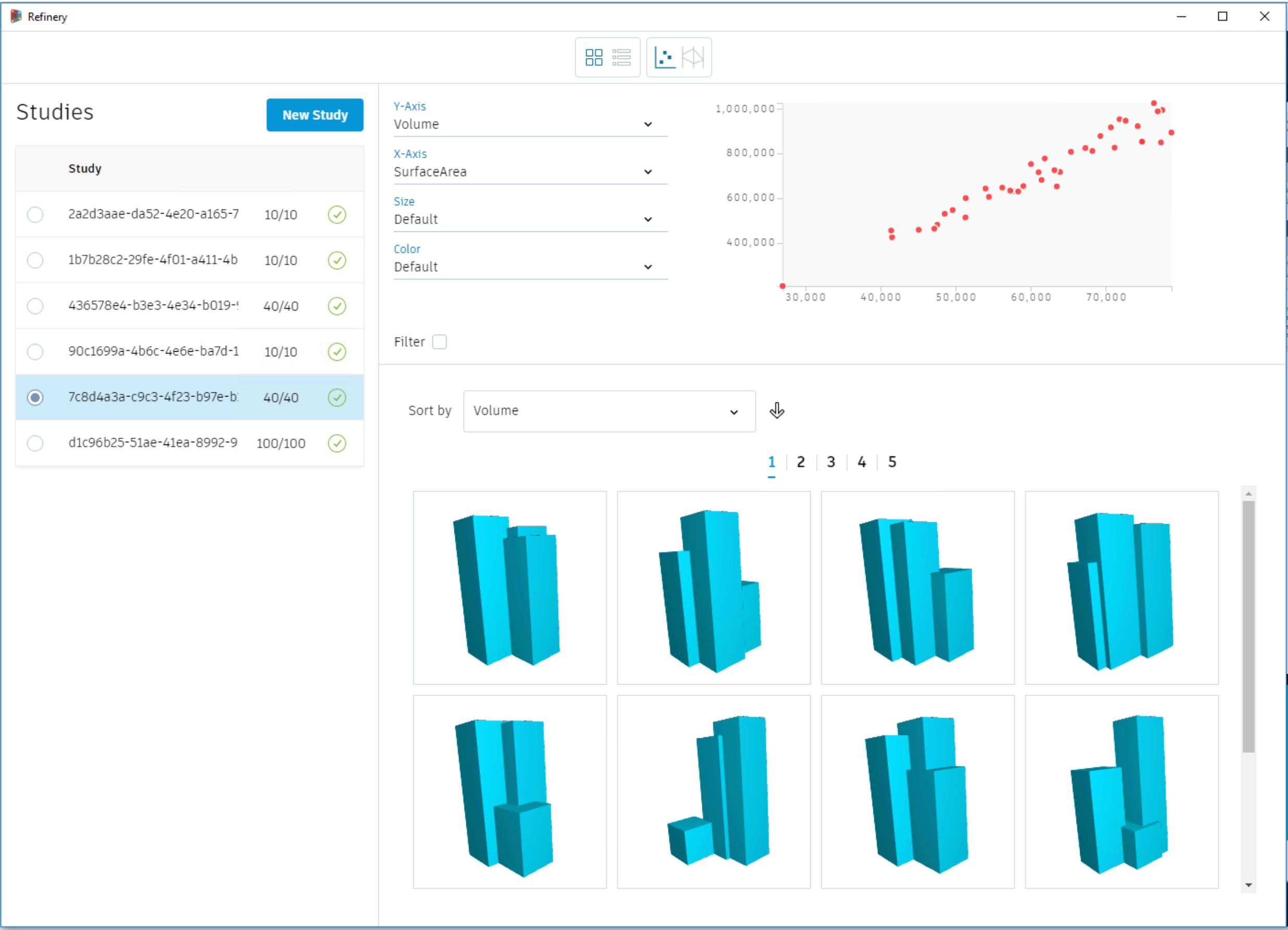
1

Enter a number to control where randomization starts.

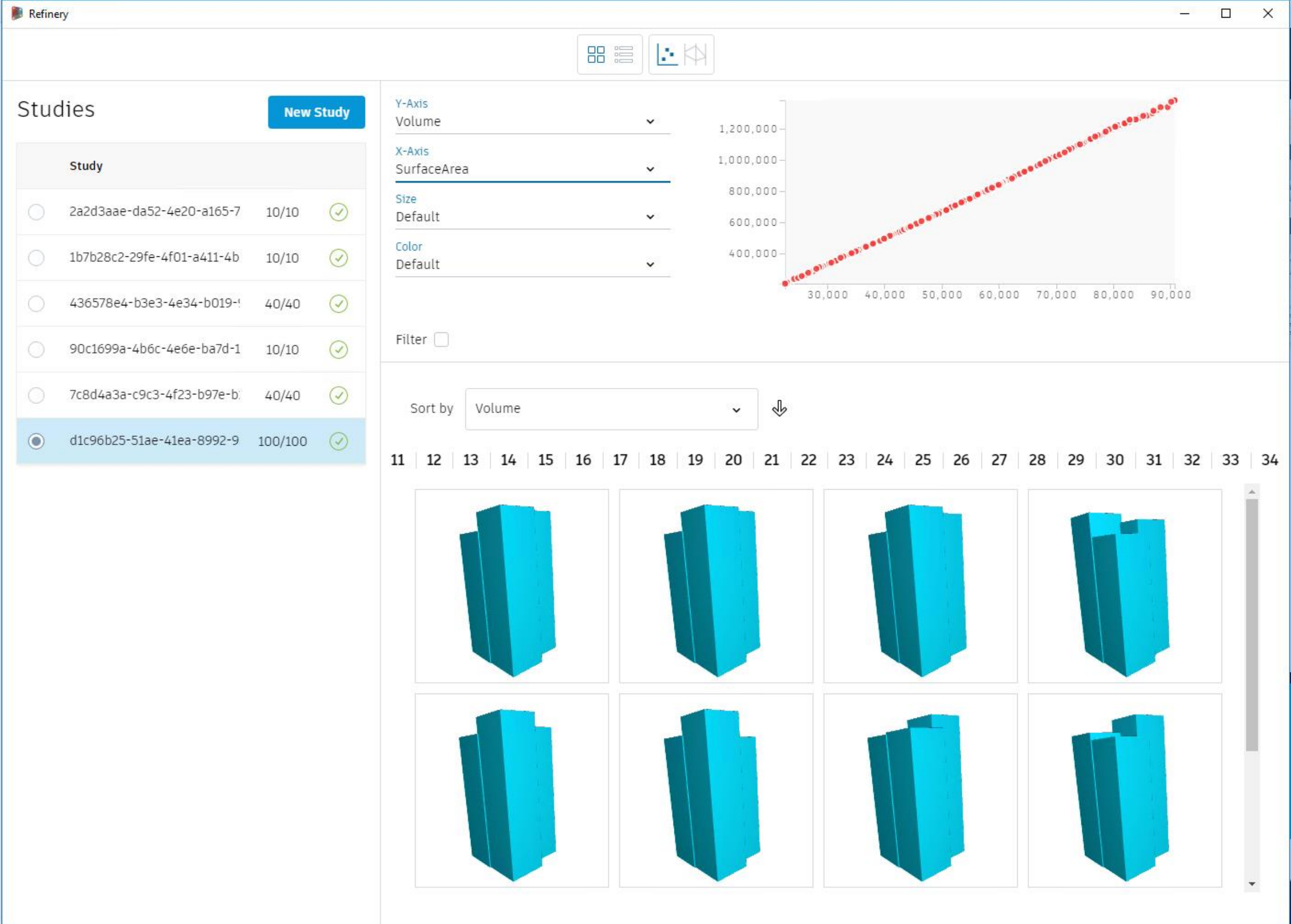
Server is running.

1 issue

Generate



40 random runs – 10 sec



100x100 optimization – 4 min

Weiterführende Infos und wichtige Links

- Refinery Info und Beta Zugang: <https://www.autodesk.com/solutions/refinery-beta>
- Dynamo Primer (auch auf Deutsch): <https://primer.dynamobim.org/>
- Refinery Primer (neu, laufend aktualisiert): <https://refineryprimer.dynamobim.org/>
- Dynamo Forum: <https://forum.dynamobim.com/>
- Kleine Tutorials, Tipps und Skripte rund um Dynamo und Refinery
jeden Dienstag (von 1. Oktober bis 31. Dezember 2019)
auf unserem BIM Blog: autode.sk/dynamo-dienstag



Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product and services offerings, and specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2019 Autodesk. All rights reserved.

